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(54) **METHOD AND SYSTEM FOR MONITORING INTOXICATION**

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G08B 1/08 (2006.01)
G08B 21/02 (2006.01)
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CPC ***G08B 21/02*** (2013.01); *A61B 5/082* (2013.01); ***A61B 5/18*** (2013.01); *A61B 5/4023* (2013.01); *A61B 5/4863* (2013.01); *A61B 2562/0219* (2013.01); ***G01N 33/4972*** (2013.01)

(58) **Field of Classification Search**
CPC G08B 21/02; G01N 33/4972; A61B 5/18
USPC 340/576, 439, 539.12; 180/272; 600/300, 309
See application file for complete search history.

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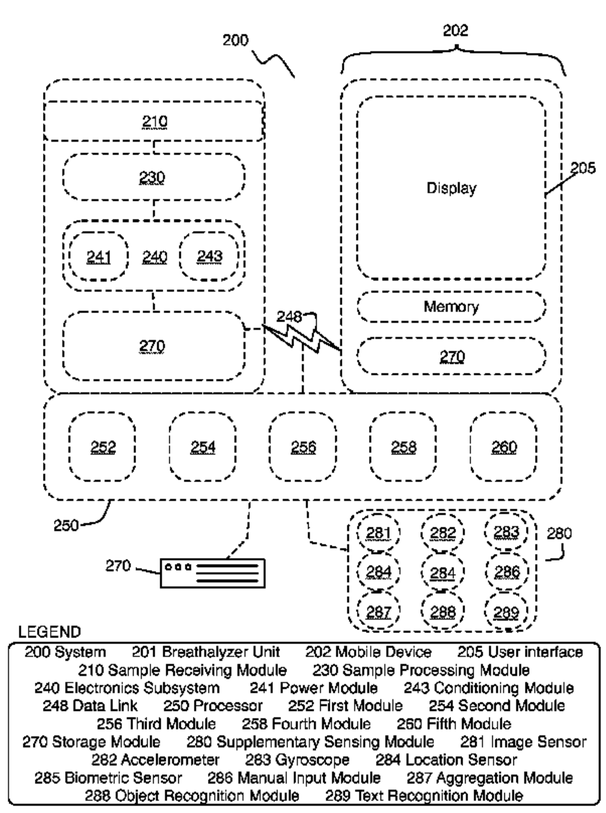
(74) *Attorney, Agent, or Firm* — Jeffrey Schox; Ivan Wong

(57) **ABSTRACT**

A method and system for monitoring a user's intoxication including receiving a set of signals, derived from a set of samples collected from the user at a set of time points; providing a sobriety task to the user proximal to a time point of the set of time points; generating a performance dataset characterizing performance of the sobriety task by the user; receiving a supplementary dataset characterizing a demographic profile of the user and/or a physiological state of the user; determining a set of values of an intoxication metric, derived from the set of signals; generating a predicted temporal profile of the intoxication metric for the user based upon the set of values, the set of time points, and the supplementary dataset; generating an analysis of the user's sobriety based upon the performance dataset and the predicted temporal profile; and providing a notification to the user based upon the analysis.

19 Claims, 10 Drawing Sheets



(51) **Int. Cl.**

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A61B 5/08	(2006.01)
A61B 5/00	(2006.01)

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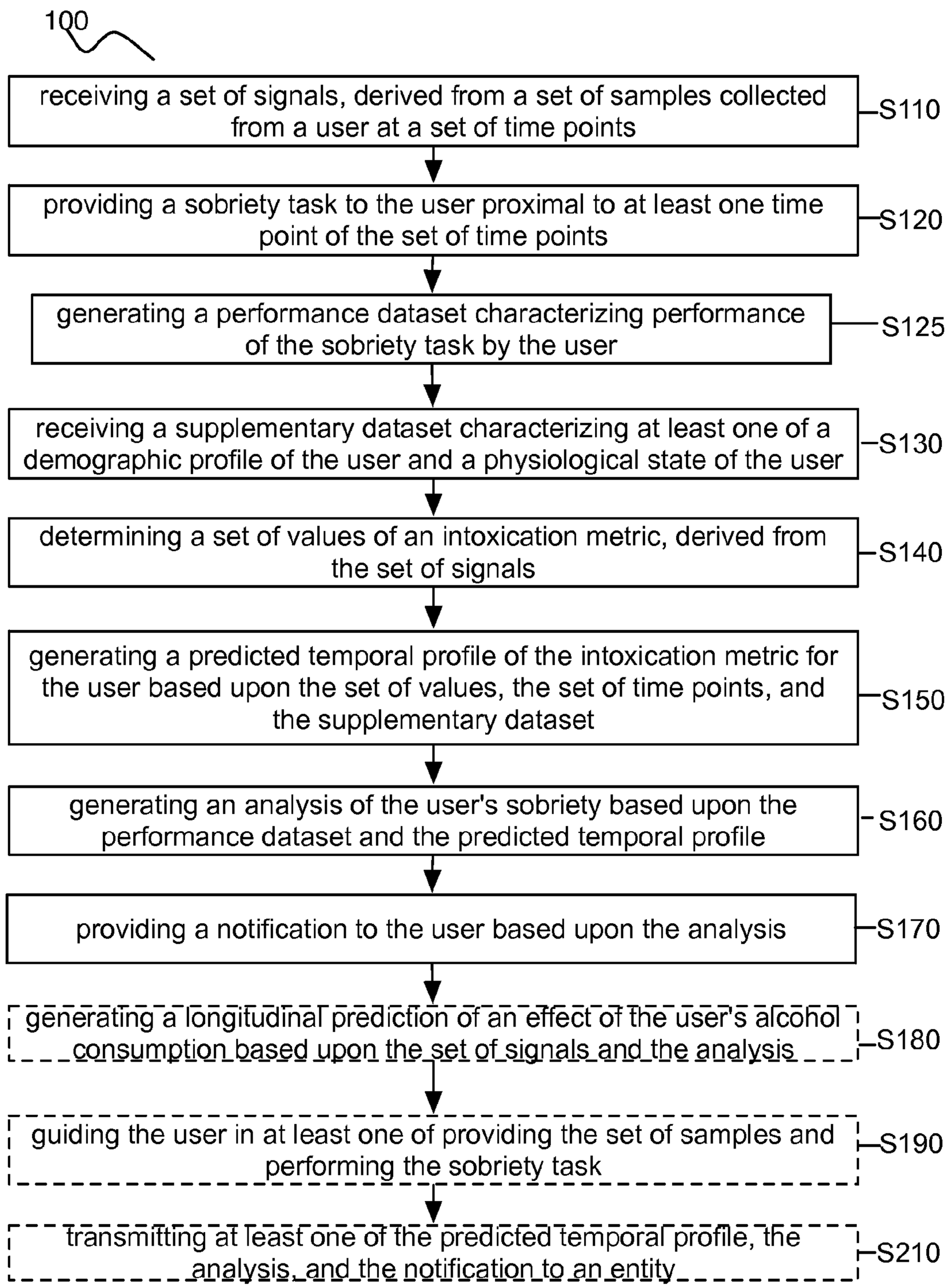

100
receiving a set of signals, derived from a set of samples collected from a user at a set of time points
S110
providing a sobriety task to the user proximal to at least one time point of the set of time points
S120
generating a performance dataset characterizing performance of the sobriety task by the user
S125
receiving a supplementary dataset characterizing at least one of a demographic profile of the user and a physiological state of the user
S130
determining a set of values of an intoxication metric, derived from the set of signals
S140
generating a predicted temporal profile of the intoxication metric for the user based upon the set of values, the set of time points, and the supplementary dataset
S150
generating an analysis of the user's sobriety based upon the performance dataset and the predicted temporal profile
S160
providing a notification to the user based upon the analysis
S170
generating a longitudinal prediction of an effect of the user's alcohol consumption based upon the set of signals and the analysis
S180
guiding the user in at least one of providing the set of samples and performing the sobriety task
S190
transmitting at least one of the predicted temporal profile, the analysis, and the notification to an entity
S210

FIGURE 1

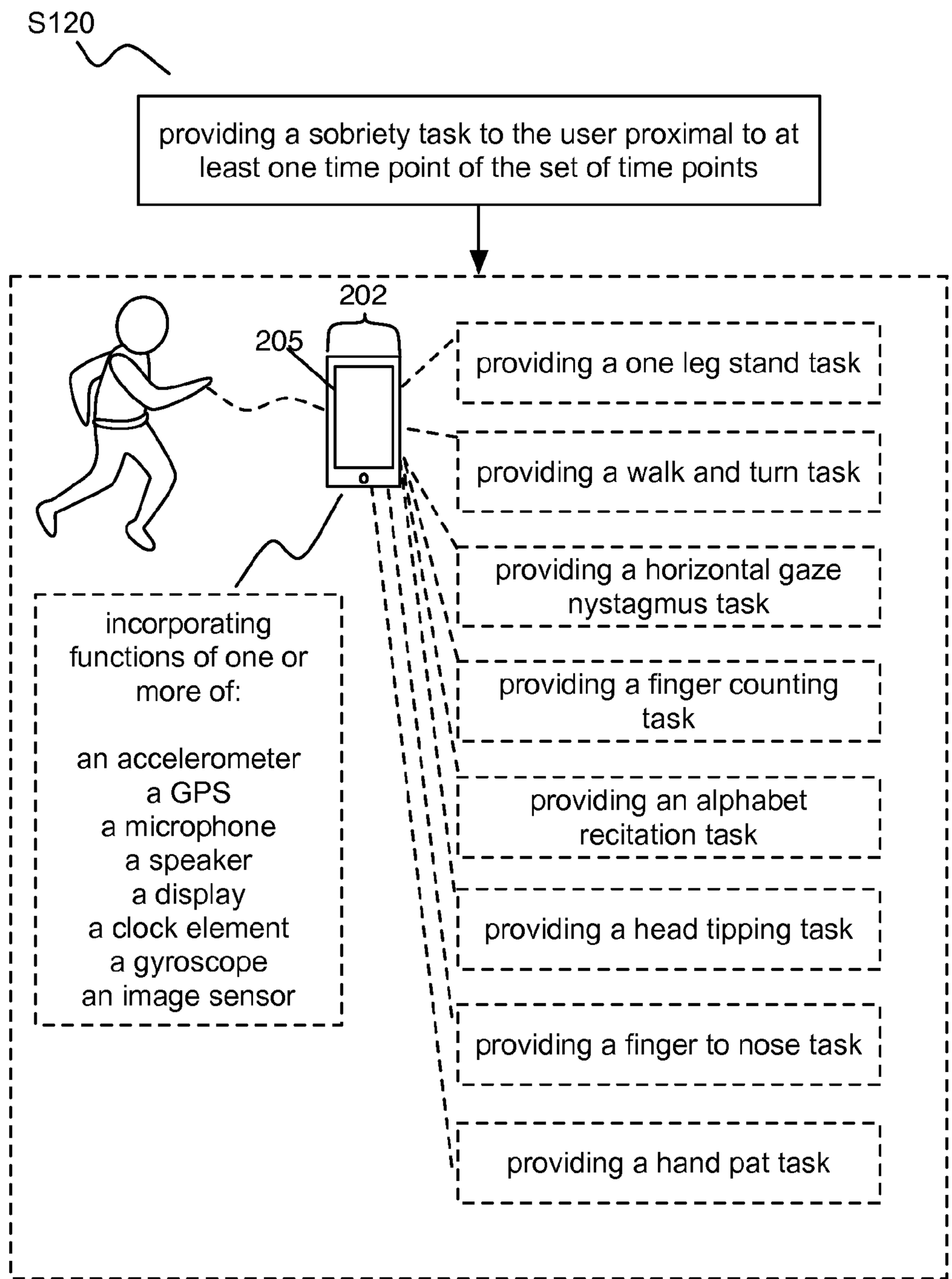

S120
providing a sobriety task to the user proximal to at least one time point of the set of time points
202
205
incorporating functions of one or more of:
an accelerometer
a GPS
a microphone
a speaker
a display
a clock element
a gyroscope
an image sensor
providing a one leg stand task
providing a walk and turn task
providing a horizontal gaze nystagmus task
providing a finger counting task
providing an alphabet recitation task
providing a head tipping task
providing a finger to nose task
providing a hand pat task

FIGURE 2

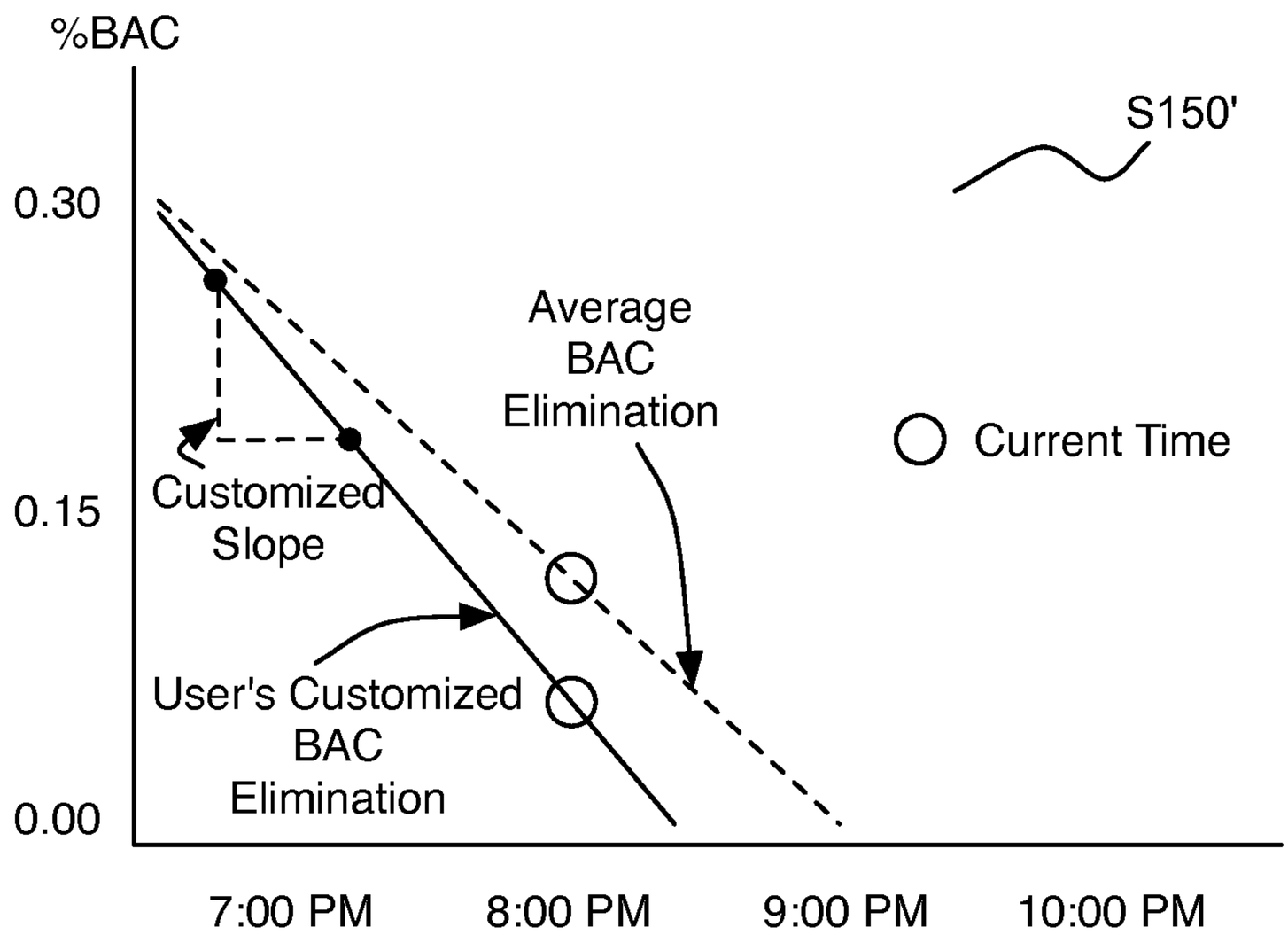


FIGURE 3A

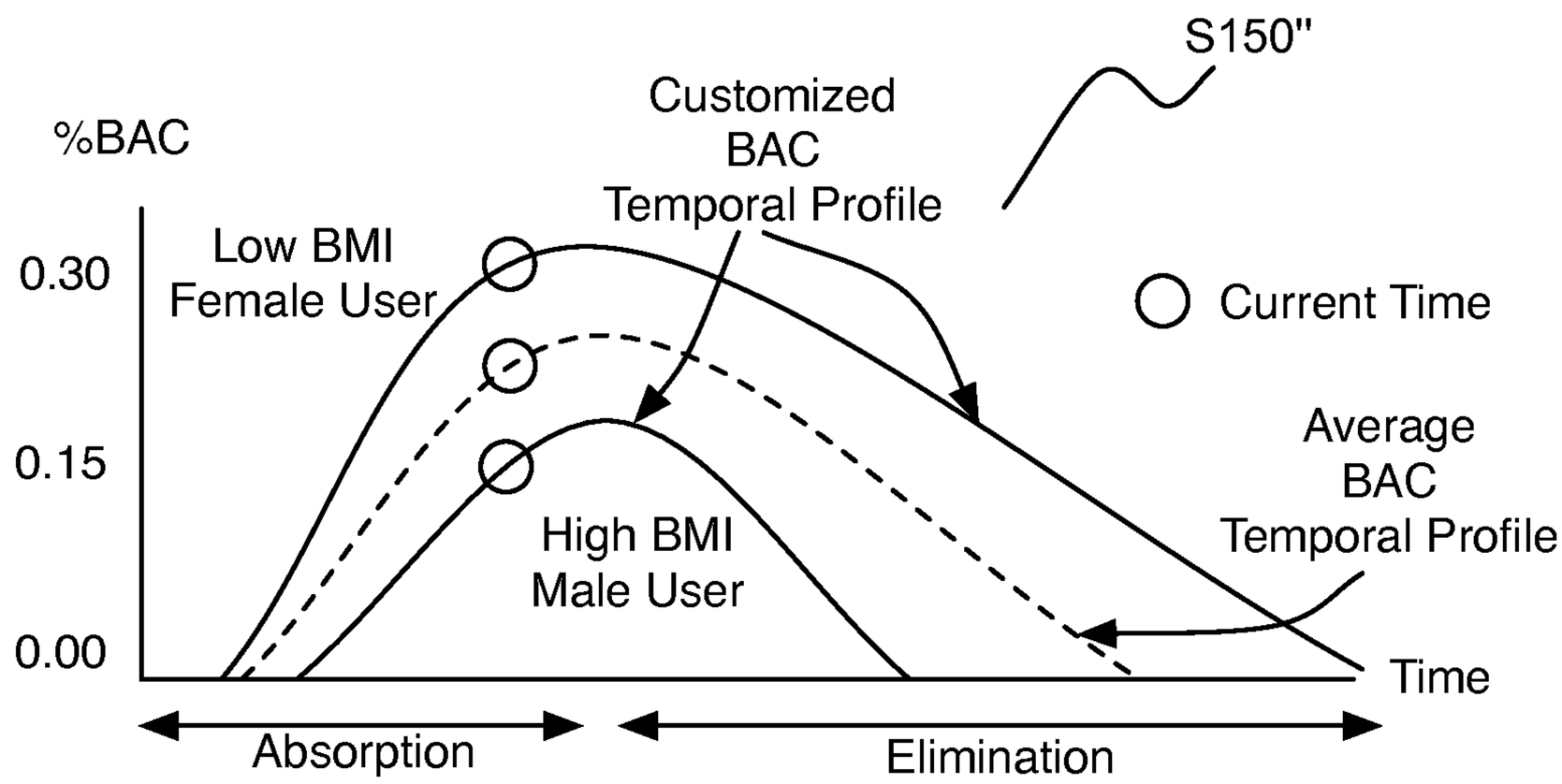


FIGURE 3B

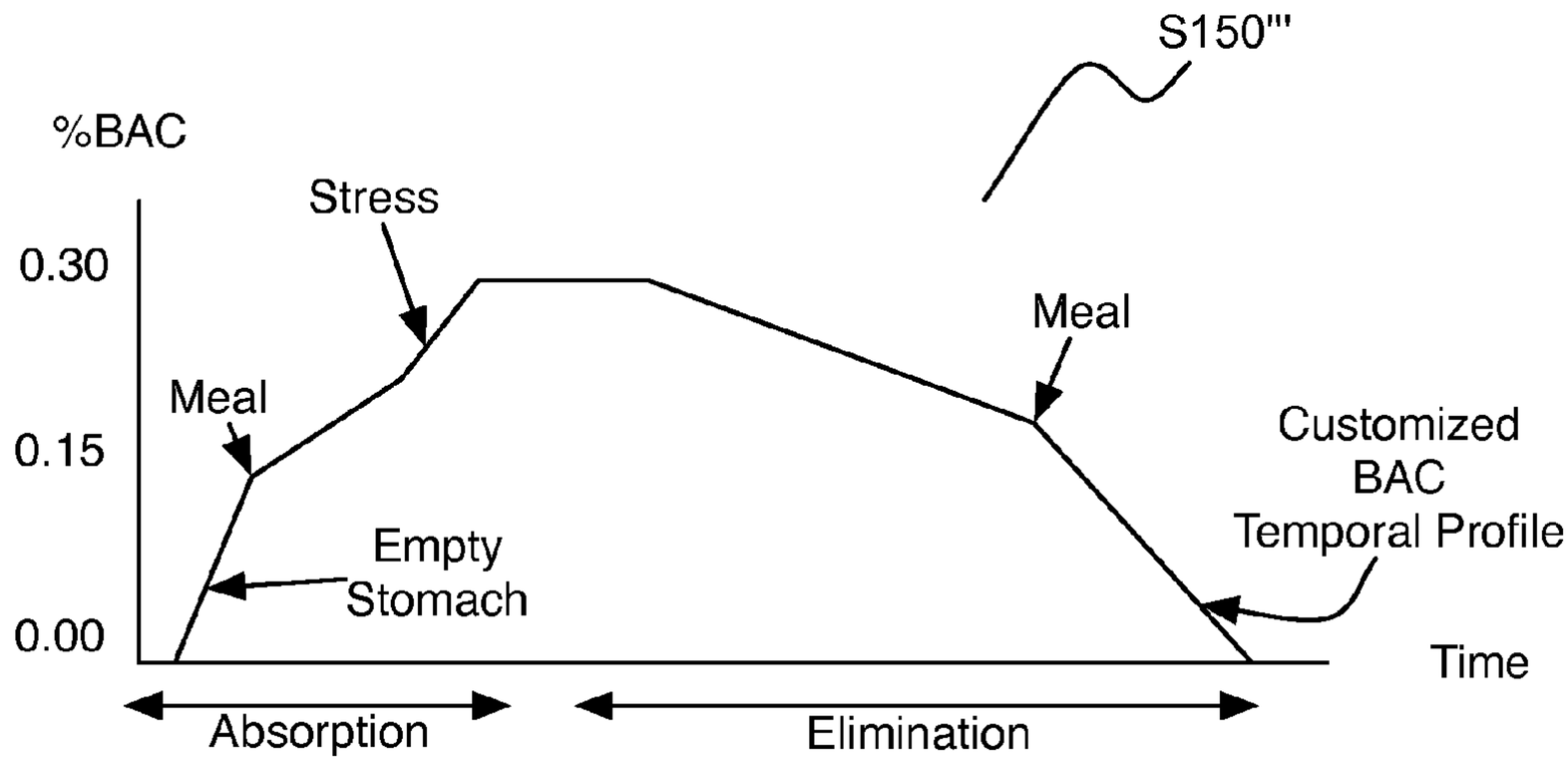


FIGURE 3C

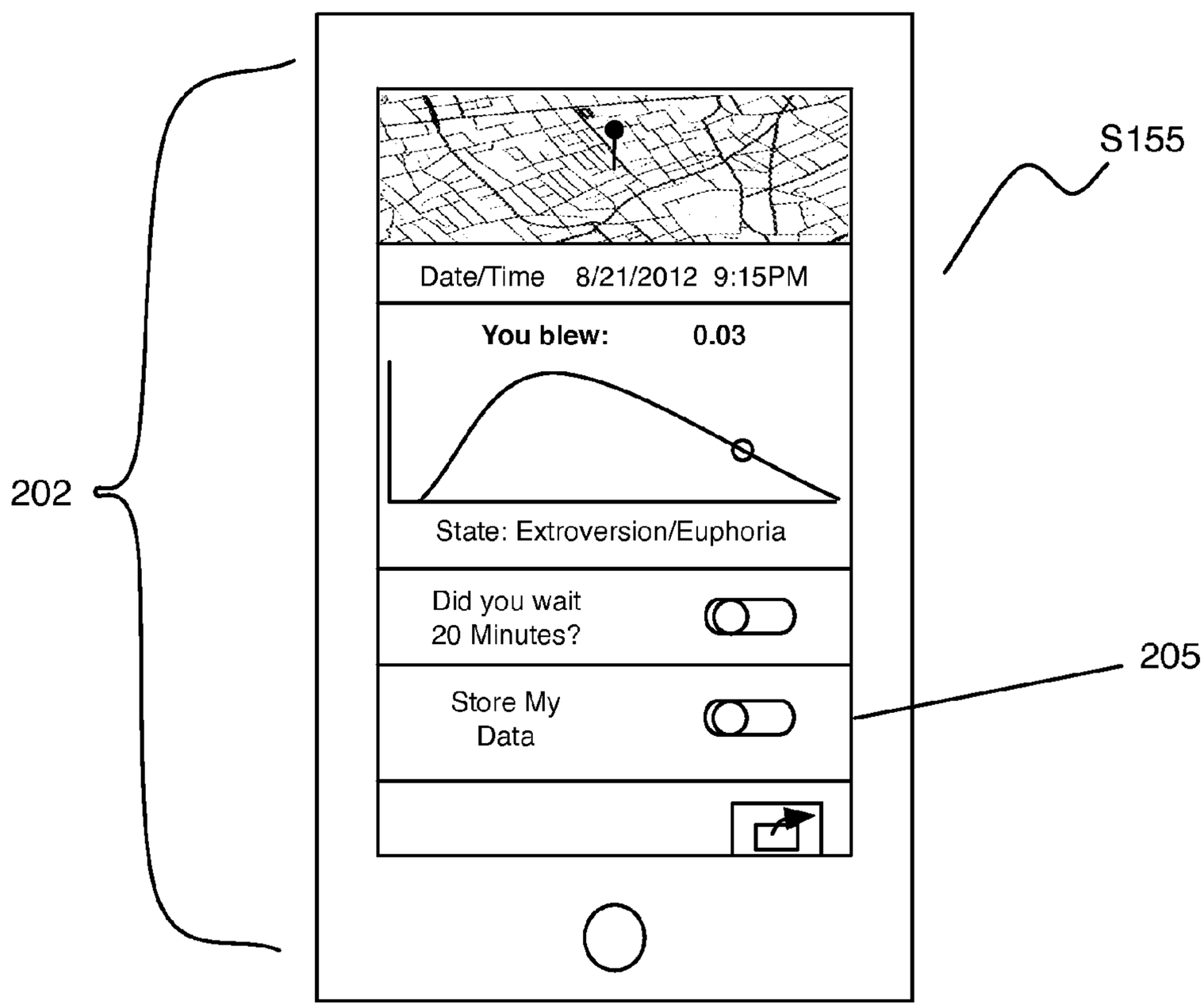


FIGURE 4

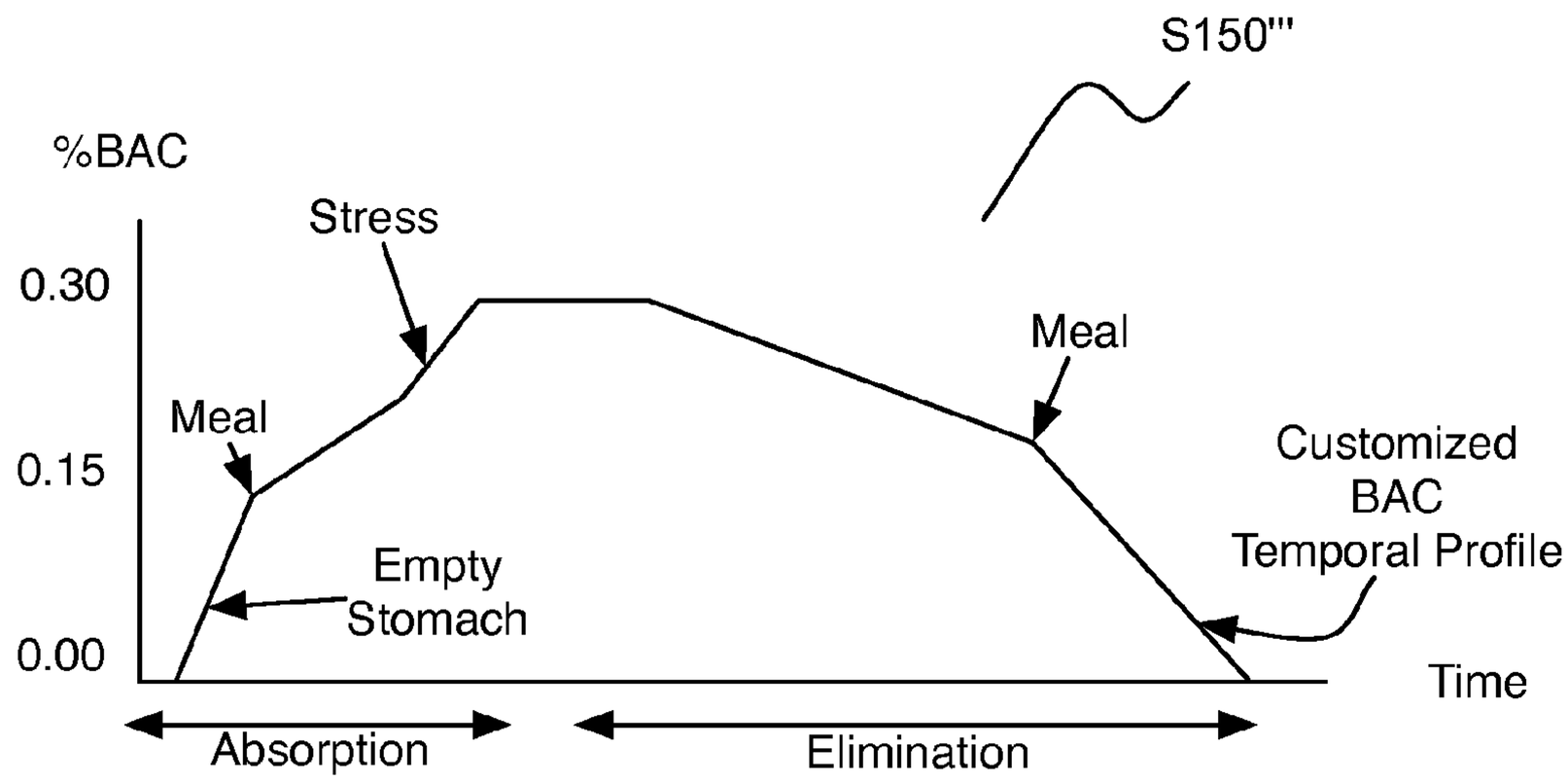


FIGURE 5A

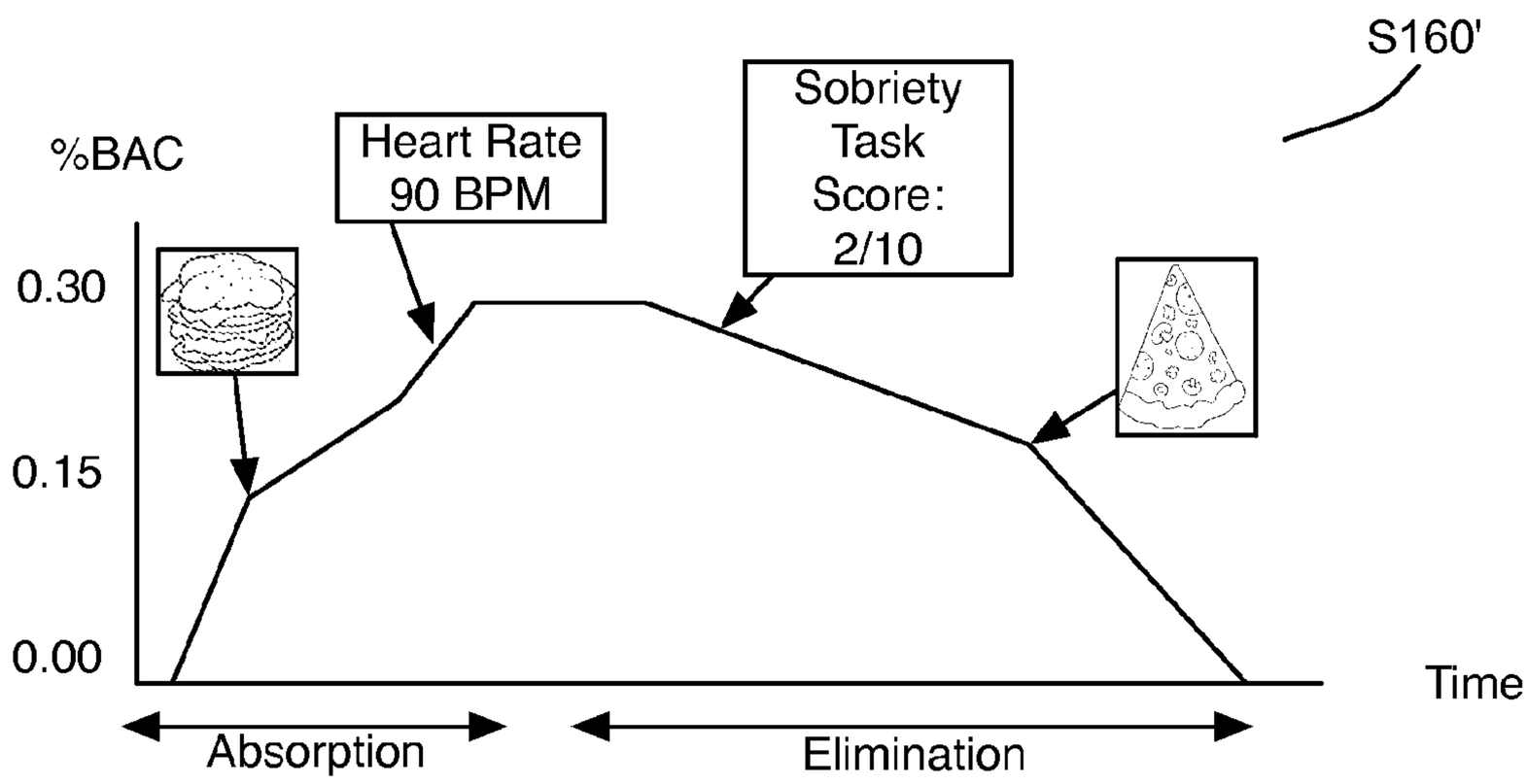


FIGURE 5B

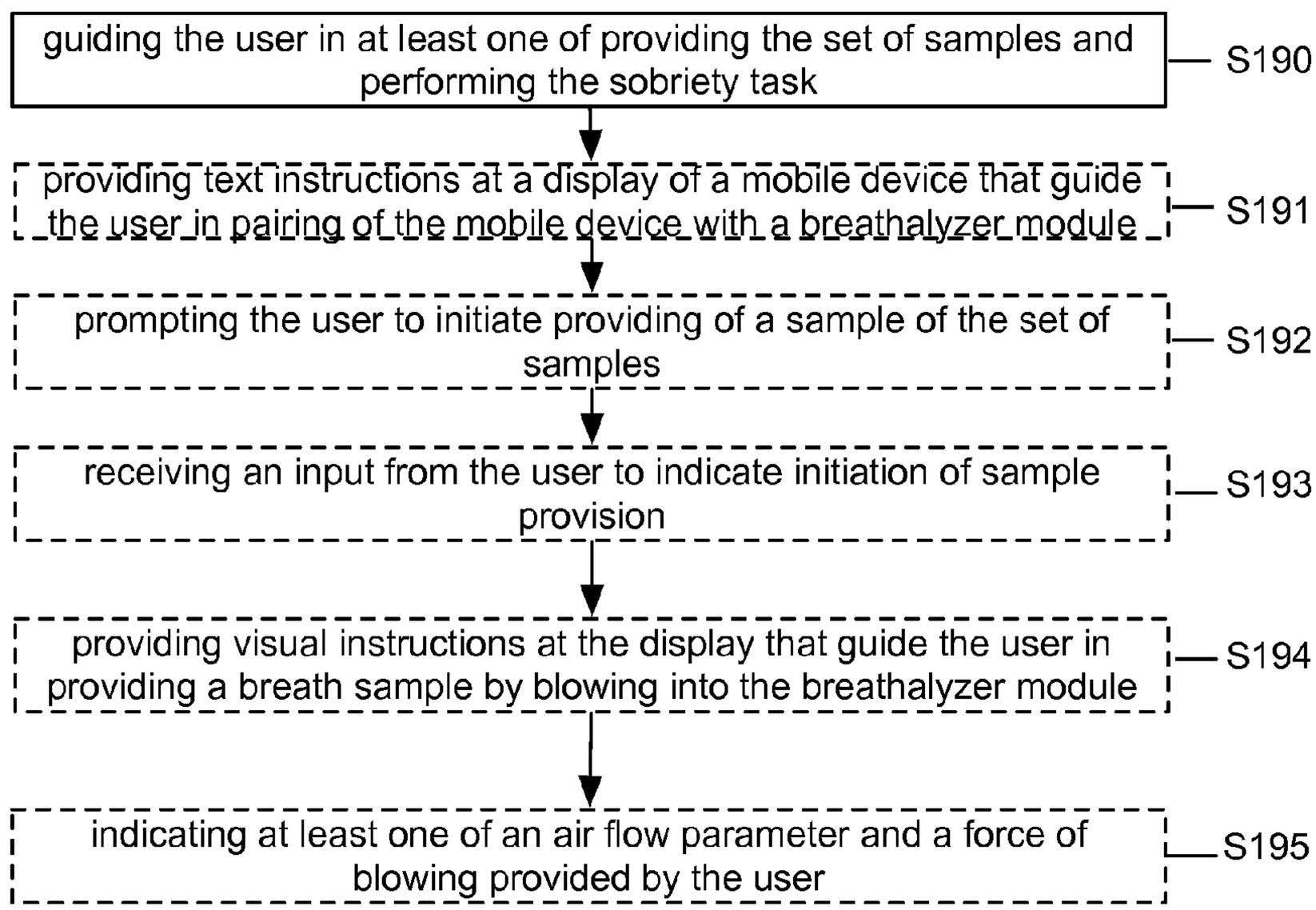
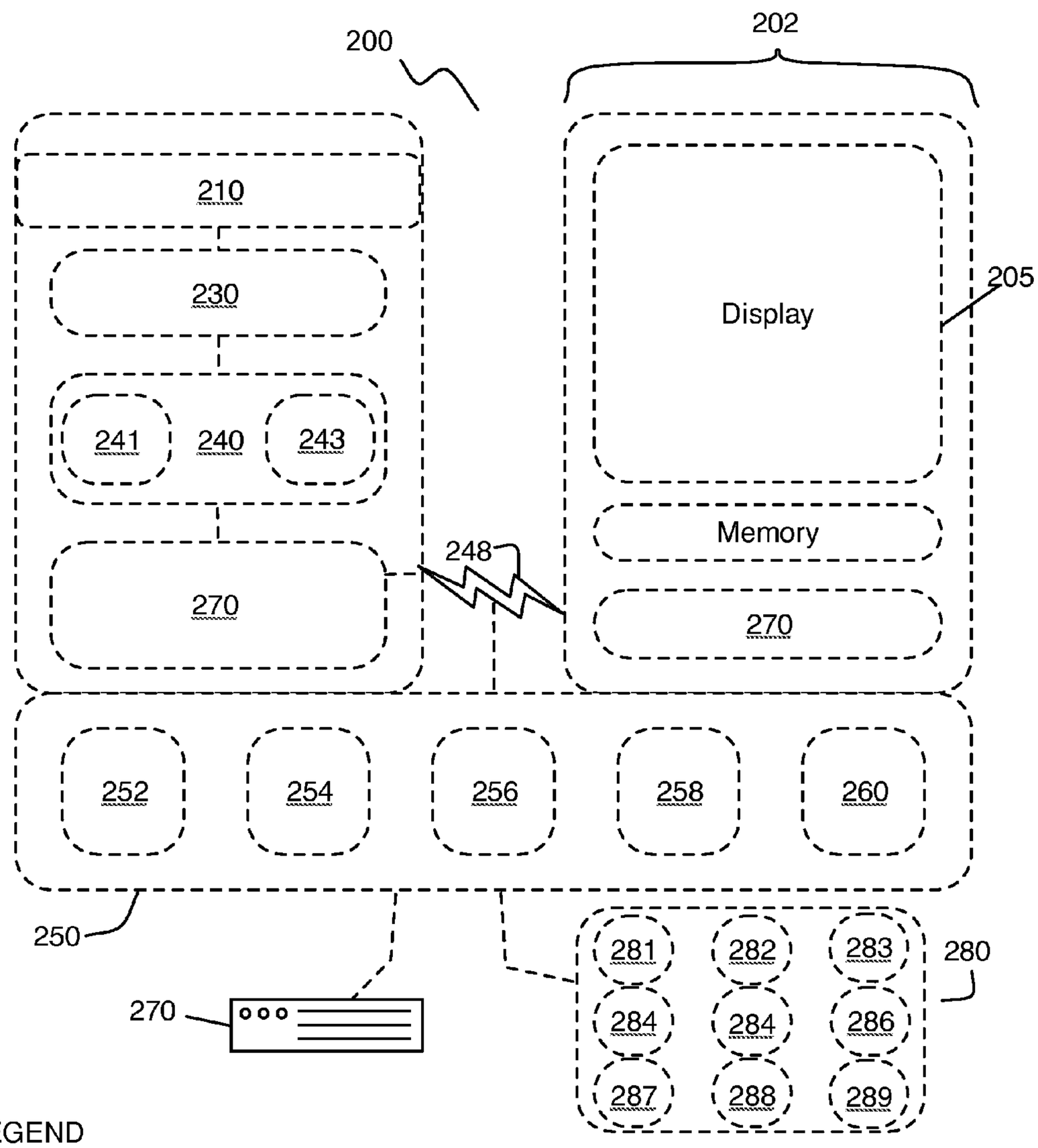

guiding the user in at least one of providing the set of samples and performing the sobriety task
S190
providing text instructions at a display of a mobile device that guide the user in pairing of the mobile device with a breathalyzer module
S191
prompting the user to initiate providing of a sample of the set of samples
S192
receiving an input from the user to indicate initiation of sample provision
S193
providing visual instructions at the display that guide the user in providing a breath sample by blowing into the breathalyzer module
S194
indicating at least one of an air flow parameter and a force of blowing provided by the user
S195

FIGURE 6



LEGEND

200 System 201 Breathalyzer Unit 202 Mobile Device 205 User interface
210 Sample Receiving Module 230 Sample Processing Module
240 Electronics Subsystem 241 Power Module 243 Conditioning Module
248 Data Link 250 Processor 252 First Module 254 Second Module
256 Third Module 258 Fourth Module 260 Fifth Module
270 Storage Module 280 Supplementary Sensing Module 281 Image Sensor
282 Accelerometer 283 Gyroscope 284 Location Sensor
285 Biometric Sensor 286 Manual Input Module 287 Aggregation Module
288 Object Recognition Module 289 Text Recognition Module

FIGURE 7A

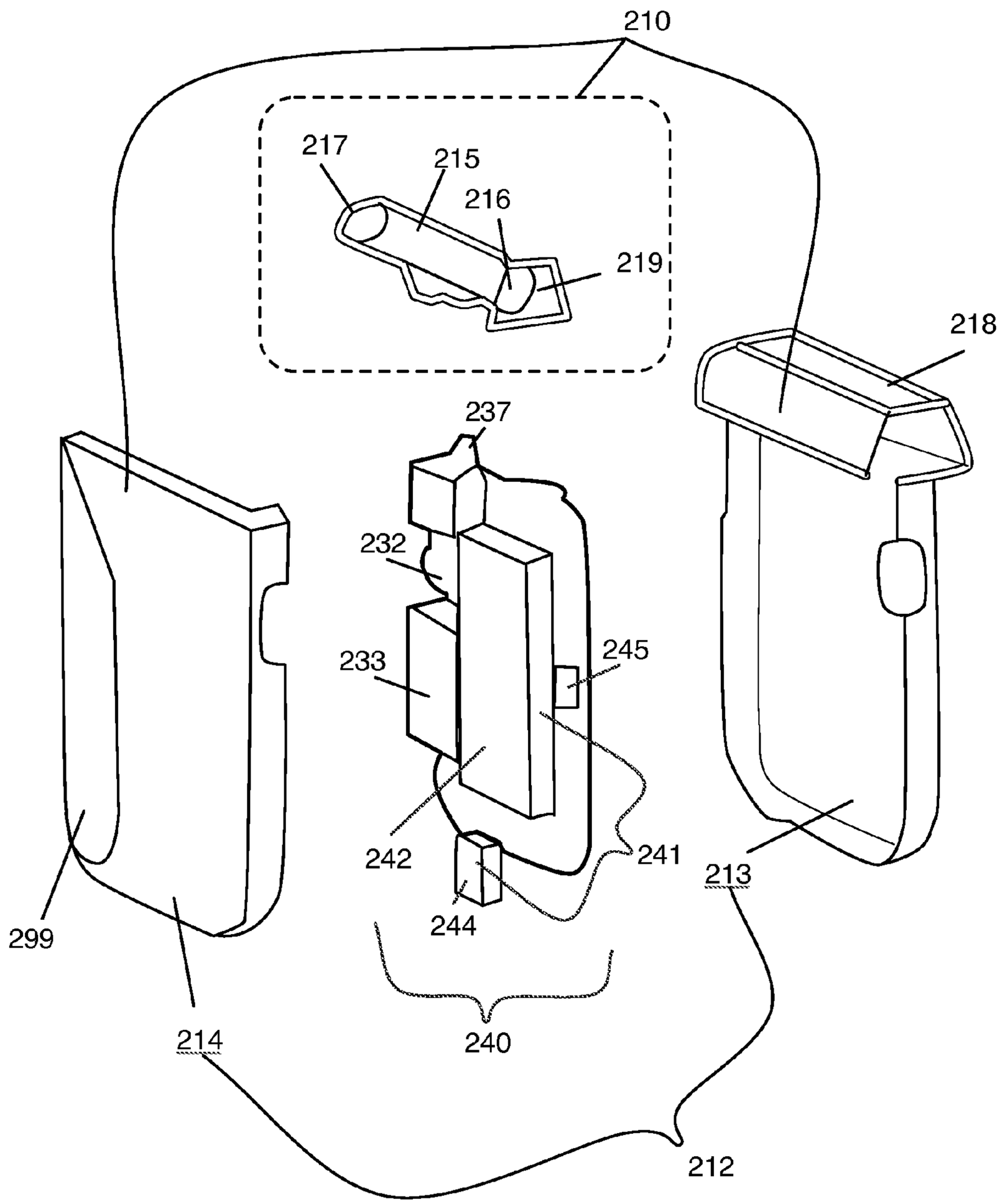

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FIGURE 7B

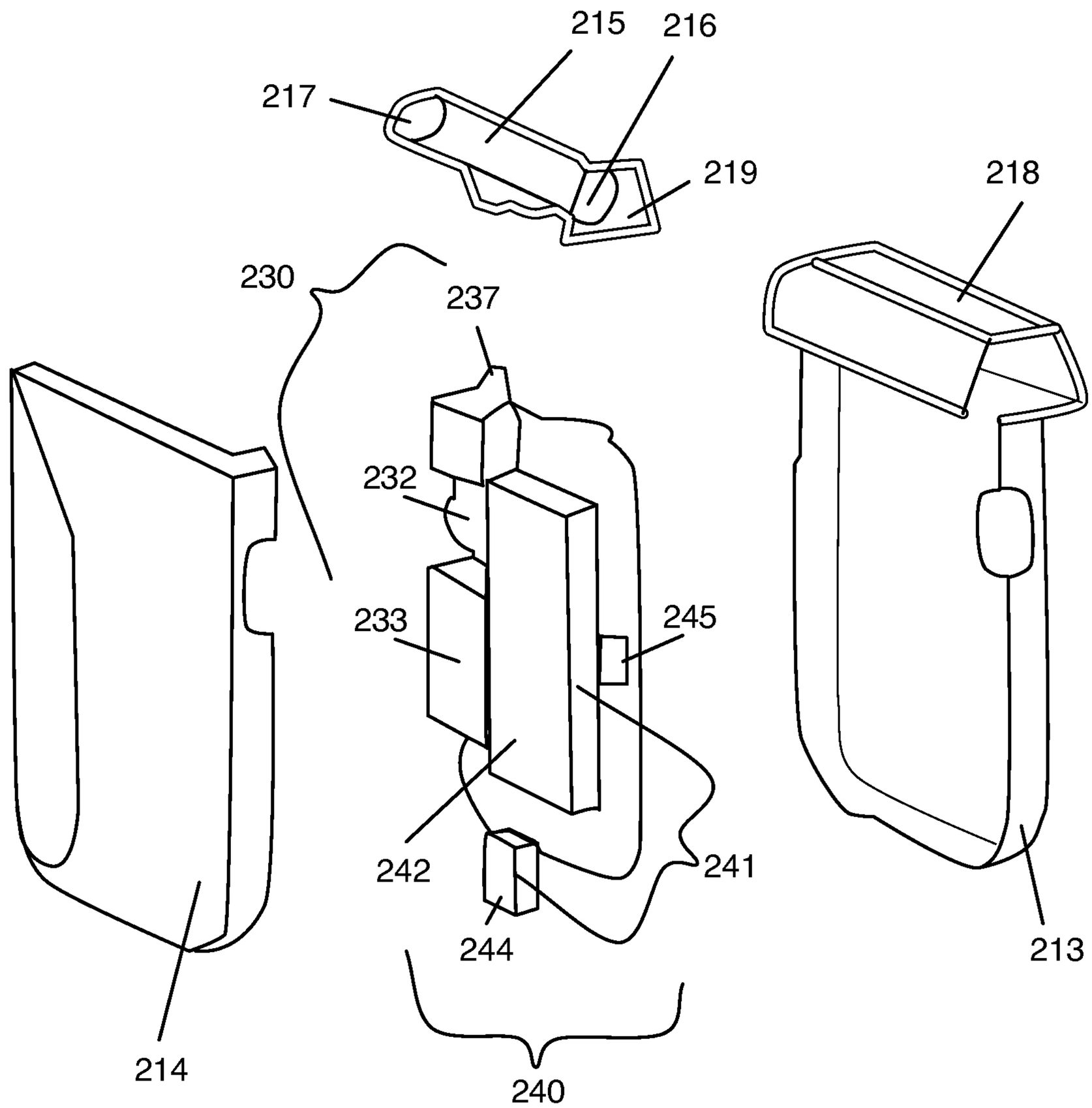

FIGURE 7C

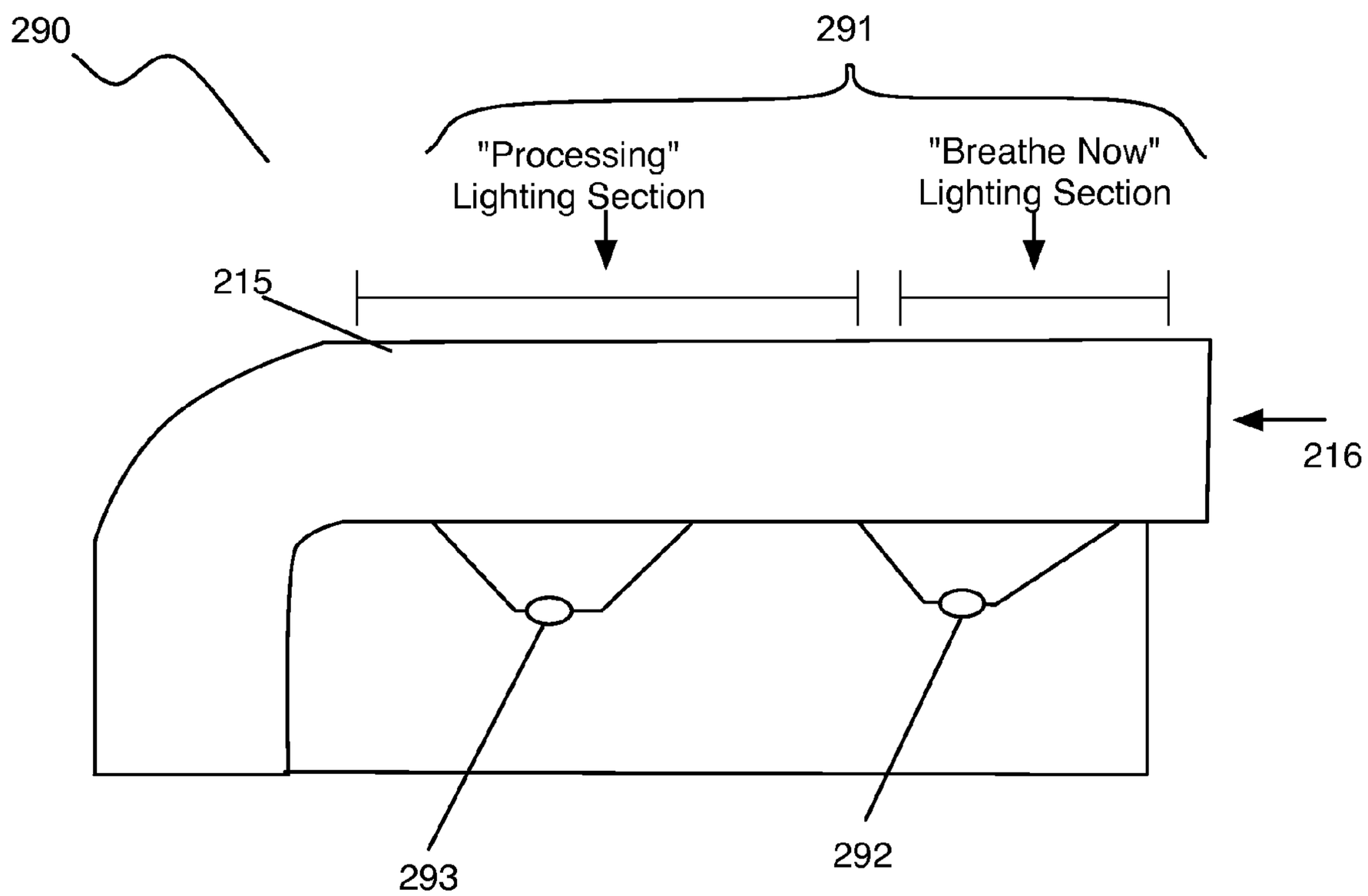
290
291
"Processing"
Lighting Section
"Breathe Now"
Lighting Section
215
216
293
292

FIGURE 8

METHOD AND SYSTEM FOR MONITORING INTOXICATION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of U.S. Pat. No. 8,878,669 filed 30Jan. 2014, which claims the benefit of U.S. Provisional Application Ser. No. 61/812,704 filed 16 Apr. 2013 and U.S. Provisional Application Ser. No. 61/759,390 filed 31 Jan. 2013, which are each incorporated in their entirety herein by this reference.

TECHNICAL FIELD

This invention relates generally to the intoxication monitoring device field, and more specifically to a new and useful method and system for monitoring intoxication.

BACKGROUND

It is often desirable to analyze a biological sample from a person to detect substances carried in the biological sample. As such, breathalyzer devices are used to test the content of alcohol (i.e., ethanol) carried in an individual's breath, in order to determine a measure of alcohol consumed by the individual. The measure is typically presented as a blood alcohol content (BAC), which can provide an indication of a user's mental and/or physical adeptness. As such, BAC measures are also used to provide a basis for limits of alcohol consumption in relation to the performance of tasks, including driving a vehicle, operating machinery, and performing various tasks in a working environment. While current blood alcohol measuring devices are able to determine an individual's BAC, and are typically used in law enforcement settings, existing systems and methods configured to provide monitoring of alcohol consumption are severely limited.

There is thus a need in the intoxication monitoring device field to create a new and useful method and system for monitoring intoxication. This invention provides such a new and useful method and system.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** depicts a schematic of an embodiment of a method for monitoring intoxication;

FIG. **2** depicts a schematic of a portion of an embodiment of a method for monitoring intoxication;

FIGS. **3**A-**3**C depict embodiments of generating a predicted temporal profile that facilitates monitoring of the user's intoxication;

FIG. **4** depicts an example of an analysis, notification, and device/user interface configured to facilitate monitoring of the user's intoxication;

FIGS. **5**A-**5**B depict examples of an analysis configured to facilitate monitoring of the user's intoxication;

FIG. **6** depicts a schematic of a portion of an embodiment of a method for monitoring intoxication;

FIGS. **7**A-**7**C depict schematics of embodiments of a system for monitoring intoxication; and

FIG. **8** depicts an example of a portion of a system for monitoring intoxication.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following description of the preferred embodiments of the invention is not intended to limit the invention to these

preferred embodiments, but rather to enable any person skilled in the art to make and use this invention.

1. Method

As shown in FIG. **1**, an embodiment of a method **100** for monitoring intoxication of a user includes: receiving a set of signals, derived from a set of samples collected from the user at a set of time points S**110**; providing a sobriety task to the user proximal to at least one time point of the set of time points S**120**; generating a performance dataset characterizing performance of the sobriety task by the user S**125**; receiving a supplementary dataset characterizing at least one of a demographic profile of the user and a physiological state of the user S**130**; determining a set of values of an intoxication metric, derived from the set of signals S**140**; generating a predicted temporal profile of the intoxication metric for the user based upon the set of values, the set of time points, and the supplementary dataset S**150**; generating an analysis of the user's sobriety based upon the performance dataset and the predicted temporal profile S**160**; and providing a notification to the user based upon the analysis S**170**. The method **100** can further comprise generating a longitudinal prediction of an effect of the user's alcohol consumption, based upon the set of signals and the analysis S**180**; guiding the user in at least one of providing the set of samples and performing the sobriety task S**190**; and transmitting at least one of the predicted temporal profile, the analysis, and the notification to an entity S**210**.

The method **100** functions to provide a tool that allows a user to monitor his/her alcohol consumption and behavioral effects of intoxication in a compelling and intuitive manner. The method **100** can also function to guide a user's behavior at various stages of intoxication, by providing notifications related to the user's intoxication state. In this regard, the method **100** can provide short-term and/or long-term predictions of a state of the user, in quantitative and qualitative manners, such that the user learns about the physiological and/or behavioral effects of his/her alcohol consumption. The method **100** can also incorporate a social component, wherein information related to a user's intoxication-induced behavior and/or physiological state can be communicated to another entity (e.g., a supervisor, a caretaker, a family member, an acquaintance).

Preferably, at least a subset of the method **100** is implemented using a portion of the system **200** described in Section 2 below, comprising a sample receiving module **210** configured to receive a set of samples from the user, a data link **248** configured to communicate signals derived from the set of samples, and a processor **250** configured to receive and process data in order to generate a notification that can be provided to the user at a user interface **205**; however, the method **100** can be implemented using any other suitable system configured to collect and/or transmit samples from the user, analyze the samples, and provide information regarding the user's intoxication state. In one specific example, the method **100** is implemented at least in part using a breathalyzer unit including a wireless data link, a processor **250**, and a mobile device **202** executing an application with a user interface **205** configured to receive inputs and provide information to the user. As such, the method **100** is preferably implemented for a user who is substantially removed from law enforcement personnel; however, the method **100** can alternatively be implemented for a user who is in proximity to law enforcement personnel.

Block S**110** recites: receiving a set of signals, derived from a set of samples collected from the user at a set of time points, and functions to enable generation of data that can be used to determine a predicted temporal profile of an intoxication

metric. The set of signals is preferably received at processor, such as the processor described in Section 2 below; however, the set of signals can alternatively be received at any other suitable processing element configured to transform the set of signals into a set of values of an intoxication metric. Block **S110** is preferably enabled using a sample receiving module that is configured to collect the set of samples from the user. As such, the set of samples can be collected automatically and/or manually, can be collected continuously and/or intermittently, and can be collected at regular and/or irregular intervals. Furthermore, the set of samples can include any one or more of: breath samples (e.g., samples collected at a breathalyzer unit), urine samples, blood samples, interstitial fluid samples, and any other suitable sample that can be used to assess the user's intoxication.

Preferably, the set of samples is received from the user in Block **S110** in a non-invasive manner; however, the set of samples can be received in a minimally invasive or invasive manner. Furthermore, in some variations, the set of signals can be received without directly collecting samples from the user; for example, the set of signals can be generated in an indirect manner, as derived from an interaction between a stimulus and the user's body (e.g., spectrometer-based analysis of light transmitted from a user's blood vessels). In still other variations, Block **S110** can entirely omit using a set of samples from the user, and instead rely upon characteristics of the user and the user's alcohol consumption (e.g., gender, mass, number of drinks consumed, time over which the drinks have been consumed, etc.) to facilitate generation of values of an intoxication metric. In one such example, data used as inputs in a Widmark formula or a derivative thereof can be received in Block **S110**.

In a specific example of Block **S110**, the set of signals can be received wirelessly using a Bluetooth transmission module incorporated into a breathalyzer unit configured to collect one or more breath samples from a user at one or more stages of intoxication. In the specific example, a sample of the set of samples can be collected at the breathalyzer unit prior to cessation of alcohol consumption by the user, and/or a sample of the set of samples can be collected at the breathalyzer unit post-cessation of alcohol consumption by the user.

Block **S120** recites: providing a sobriety task to the user proximal to at least one time point of the set of time points. Block **S120** functions to enable an assessment of the user's abilities (e.g., motor ability, sensory ability, cognitive ability, etc.) associated with at least one state of intoxication, as determined from the set of samples collected from the user. The sobriety task is preferably provided to the user at a user interface in an electronic format, and in some variations, can be provided to the user at a user interface of an application executing at an electronic device (e.g., mobile device) of the user. As such, the sobriety task is preferably implemented in a manner that incorporates functions enabled by sensors and components of the electronic device, including one or more of motion detection (e.g., by an accelerometer), location detection (e.g., by a GPS), audio detection (e.g., by a microphone), audio stimulation (e.g., by a speaker), visual stimulation (e.g., at a display), reaction time detection (e.g., by a user input module and a clock element), orientation detection (e.g., by a gyroscope), optical detection (e.g., at an optical sensor, at an image sensor), and any other suitable function. However, the motor still task can alternatively be provided to the user in a non-electronic format (e.g., by a supervisor, by law enforcement personnel, by a caretaker, by a family member of the user, by an acquaintance of the user).

The sobriety task is preferably presented to the user proximal in time to each time point of the set of time points wherein the user provides a sample, such that performance of the sobriety task by the user can be directly associated with an intoxication metric derived from the sample. Furthermore the sobriety task can be provided to the user with at least one round of repetition, such that deviations between repeat performances and average performance metrics can be assessed. In examples, the sobriety task can be presented to the user in any one or more of the following configurations: prior to (e.g., immediately prior to) provision of a breath sample by the user at a breathalyzer, after (e.g., immediately after) provision of a breath sample by the user at a breathalyzer, and concurrently with provision of a breath sample by the user at a breathalyzer. However, in other variations, the sobriety task can additionally or alternatively be provided to the user substantially removed in time from a time point at which a sample is provided by the user, such that performance of the sobriety task by the user is not directly associated with an intoxication metric derived from a collected sample. In these variations, the user's performance of the sobriety task can, for example, be associated with a predicted value of an intoxication metric (e.g., from the predicted temporal profile generated in Block **S150**), or can, for example, be used to predict the value of an intoxication metric of the user without collection of a sample from the user.

The sobriety task can include a single task configured to enable an assessment of the user's abilities (e.g., motor ability, sensory ability, cognitive ability, etc.) associated with at least one state of intoxication, and in one variation, can include a test configured to gage a user's reaction to certain stimuli. In one example, the user can be presented with one or more stimuli (e.g., an audio stimulus, a visual stimulus, etc.), and the sobriety task can be used to assess the user's reaction (e.g., the user has a reaction response, the user does not have a reaction response) to the stimulus/stimuli. In another example, the user can be presented with one or more stimuli (e.g., an audio stimulus, a visual stimulus, etc.), and the sobriety task can be used to assess the user's reaction time to respond to the stimulus/stimuli. In another example, the user can be presented with a cognitive task (e.g., problem-solving task), and the user's ability to accomplish the cognitive task can assessed in Block **S160**. In yet another example, the user can be presented with a cognitive task (e.g., problem-solving task), and the duration required by the user to accomplish the cognitive task can be assessed in Block **S160**. However, the sobriety task can additionally or alternatively include any other suitable task.

In other variations, the sobriety task can include a set of tasks, which can be provided in a consistent sequence whenever the user is provided with the sobriety task(s), in a random sequence, in an adaptive sequence (e.g., based upon the user's performance of a task of the set of tasks), and/or in any other suitable sequence. Furthermore, in embodiments wherein the sobriety task includes a set of tasks, the complete set of tasks can be provided to the user upon provision of the sobriety task to the user, or an incomplete set of tasks can be provided to the user, based upon a selection from the complete set of tasks by the user or by another entity. In some variations, as shown in FIG. **2**, the set of tasks can be substantially identical to or analogous to tasks provided during a field sobriety test conducted by law enforcement personnel. In specific examples, the set of tasks can be configured to mimic field sobriety tests standardized by the National Highway Traffic and Safety Administration (NHTSA) of the United States of America, which include a one-leg stand (OLS) task, which requires a user to stand on one leg for 30 seconds to assess balance and coordination, a walk and turn (WAT) task, which assess a user's ability to balance and have his/her attention divided,

and a horizontal gaze nystagmus (HGN) task, which assess involuntary jerking of the user's eye(s), indicative of intoxication. In variations of these examples, the set of tasks can additionally or alternatively include tasks configured to mimic tasks of any non-standardized sobriety tests, including one or more of: a finger counting (FC) task configured to assess cognition and vision, an alphabet recitation (AR) task, a counting task, a task wherein the user stands and slowly tips his/her head back, which enables an assessment of balance, a finger-to-nose (FTN) task configured to assess motor acuity, a hand-pat test, wherein the user alternatingly pats one hand with the palm and the back side of the other hand, and any other suitable task.

In specific examples, wherein a set of tasks configured to mimic a field sobriety test is provided using an application executing at a mobile device of the user, the set of tasks are implemented in a manner that incorporates functions enabled by sensors and components of the electronic device. In one example, the OLS task can incorporate image sensor functions, accelerometer functions, gyroscope functions, and or clock functions to detect that the user is standing upon one leg (e.g., as enabled by the image sensor), and that the user has maintained balance for at least 30 sections (e.g., as enabled by the accelerometer, the gyroscope, and/or the clock). In another example, the WAT task can incorporate image sensor functions, accelerometer functions, and gyroscope functions to detect that the user is walking, is walking in a straight line, and is performing walking tasks according to instructions provided at a display and/or by the speaker of the mobile device. In another example, the HGN task can incorporate a moving visual stimulus at the display of the mobile device and optical sensor functions that track an eye of the user as the user visually follows the moving visual stimulus. In another example, the FC task can present a number of objects at the display of the mobile device, and the user can be instructed to identify and input the number of objects presented. In another example, the alphabet recitation task/counting task can instruct the user to recite a portion of the alphabet or count in any order, and a microphone of the mobile device can enable an assessment of the user's accuracy in reciting and/or counting. In yet another example, the FTN task can incorporate optical sensor functions, accelerometer functions, and gyroscope functions to detect the motion of the user as the user brings the mobile device in an outstretched hand to his/her nose, and has successfully performed the task (e.g., by the optical sensor).

Block S**125** recites: generating a performance dataset characterizing performance of the sobriety task by the user, and functions to analyze the user's performance of the sobriety task. The performance dataset preferably characterizes the user's abilities (e.g., motor ability, sensory ability, cognitive ability, etc.) associated with at least one sample of the set of samples, in a quantitative manner. However, the performance dataset can additionally or alternatively characterize the user's abilities in a qualitative manner. As such, the performance dataset can include quantified values of aspects of the user's performance of the sobriety task, including one or more of: total response time (e.g., response time to complete a task), average response time across repeat performances of the sobriety task, deviation in response time between repeat performances of the sobriety task, total reaction time (e.g., reaction time to a stimulus), average reaction time across repeat performances of the sobriety task, deviation in reaction time between repeat performances of the sobriety task, and any other suitable quantified variable. Additionally or alternatively, the performance dataset can include qualitative aspects of the user's performance of the sobriety task, including one or more of: performance success (e.g., the user accomplished the task, the user did not accomplish the task), performance speed (e.g., fast, medium, slow), reaction response (e.g., user reacted, user did not react), and any other suitable qualitative characteristic. As such, the performance dataset provides data that can be used to analyze the user's sobriety in Block S**160**.

Block S**130** recites: receiving a supplementary dataset characterizing at least one of a demographic profile of the user and a physiological state of the user, and functions to provide enriching data that can be used to increase the accuracy of the set of values of the intoxication metric determined in Block S**140** and/or the predictive power of the predicted temporal profile generated in Block S**150**. The supplementary dataset is preferably received at processor, such as the processor described in Section 2 below; however, the supplementary dataset can alternatively be received at any other suitable processing element configured to use the supplementary dataset in generating a set of values of an intoxication metric. In Block S**130**, the demographic profile can include any one or more of information related to: gender (e.g., male, female, etc.), age, weight, height, ethnicity, marital status, profession, geographic location, diagnosed medical conditions (e.g., diabetes, alcohol intolerance), metabolic profile (e.g., fat/muscle content), family history, genetic information, and any other suitable type of demographic-related information. In Block S**130**, the physiological state of the user can be determined based upon any one or more of information related to: food consumption (e.g., amount/rate of consumption), beverage consumption (e.g., amount/rate of consumption), medication usage, activity (e.g., exercise, rest, sleep), biometric information (e.g., heart rate, respiration rate, pupilometric information, neural activity information, etc.), emotional state (e.g., stress state), and another other suitable type of physiological state-related information. The supplementary dataset can, however, include any other suitable type of data in addition to demographic data and/physiological state data.

The supplementary dataset received in Block S**130** can be generated by manual input (e.g., by manual input from the user) and/or automatically based upon accessing of information databases relevant to the user. In variations wherein the supplementary dataset is generated by manual input, the user or another entity can manually input demographic information and/or information related to physiological state at a user input device, which is received as the supplementary dataset. In variations wherein the supplementary dataset is generated automatically, the supplementary dataset can be generated at an aggregation module configured to access, retrieve, and/or aggregate content (e.g., digital content) from different sources (e.g., social network accounts, search results, etc.). As an example, the supplementary dataset can be generated by an aggregation module configured to access and retrieve content from the user's Facebook, Twitter, and Instagram accounts, which can be used to provide demographic information, location information, and activity information (e.g., exercise regimen information, consumption information) related to a physiological state of the user. In another example, the supplementary dataset can be generated using a module configured to extract food and/or beverage consumption information from image and/or text data. The image/text data can be input by the user by way of an application executing at an electronic device (e.g., mobile device) of the user, wherein the electronic device comprises an image sensor; however, in variations of this example the image data can additionally or alternatively be accessed and retrieved using an aggregation module in communication with the user's digital networks (e.g., digital social networks). As such,

object recognition (e.g., of food items, of beverage items) and/or text recognition (e.g., of food labels, of drink labels) can be used to enable automatic identification of items that the user consumes, thus enriching the supplementary dataset. The image/text data can also be time stamped, such that the user's consumption activity can be associated in time with at least one time point of the set of time points, to facilitate generation of the predicted temporal profile in Block S**150**.

In the above examples and variations, the supplementary dataset preferably includes temporally static information (e.g., demographic information) and temporally varying information (e.g., physiological state information), but can include only temporally static information, only temporally varying information, and/or any other suitable type of information. Preferably, each piece of temporally varying information has an associated time stamp that is automatically retrieved and/or generated, such that the information can subsequently be associated with temporally varying intoxication states of the user predicted in variations of Block S**150**. However, the temporally varying information can additionally or alternatively be retroactively time-stamped (e.g., by a user, by another entity) in order to incorporate temporal information in the supplementary dataset.

Block S**140** recites: determining a set of values of an intoxication metric, derived from the set of signals, and functions to determine at least one value of an intoxication metric that can be used to create one or more anchoring points for the predicted temporal profile generated in Block S**150**. The intoxication metric is preferably a blood alcohol concentration (BAC), which can be determined from signals generated from one or more of: a breath sample, a urine sample, a blood sample, and any other suitable biological sample from the user, as described in relation to Block S**110** above; however, the intoxication metric can alternatively be any other suitable metric characterizing intoxication of the user. In variations wherein the set of signals is derived from breath samples of the user, a BAC value corresponding to each breath sample can be determined based upon the magnitude of an electrical signal produced when alcohol in the user's breath reacts with a sensing element of the sensor (e.g., a current magnitude produced by a platinum-alcohol oxidation reaction for a fuel cell sensor, a change in electrical resistance produced by an alcohol-dioxide reaction for a semiconductor sensor, etc.). In other variations, a BAC value corresponding to any other suitable type of sample from the user can be determined based upon an electrical signal produced in response to irradiation of the sample (e.g., by way of an electrical pulse generated in response to absorption of infrared light by the sample, using a spectrophotometer), by way of a detected chemical change (e.g., as exhibited by a color change) in response to a chemical reaction between the sample and a chemical additive, or in any other suitable manner.

Block S**150** recites: generating a predicted temporal profile of the intoxication metric for the user based upon the set of values, the set of time points, and the supplementary dataset, and functions to create a predicted temporal profile of an intoxication metric that is customized to the user and provides information regarding the user's past, present, and future states of intoxication in a quantitative and/or qualitative manner. When an individual consumes alcohol, their level of intoxication (e.g., as assessed by a BAC), will generally rise as alcohol is absorbed by their body, and then fall back to zero as alcohol is absorbed by their body. As such, the predicted temporal profile characterizes an intoxication metric vs. time for the user, which can be used to predict when the intoxication metric for a user will reach a specific value at a point in time. The predicted temporal profile can thus be generated based upon the set of values of the intoxication metric generated in Block S**140** as anchoring points, as well as average profiles (e.g., rates) of alcohol absorption and elimination as determined previously from a population of individuals. Furthermore, generation of the predicted temporal profile can include forward and/or retrograde extrapolation of unknown future and/or past values of the intoxication metric, in relation to the set of values generated in Block S**140**. In an example, as shown in FIG. **3**A, one value of an intoxication metric, determined for a time point after which the user has ceased alcohol consumption, can provide an anchoring point for a region of the predicted temporal profile over which the user's intoxication is declining, and average rates of alcohol elimination as determined from a population of individuals can be used to extrapolate the decline of the intoxication metric for the user over time, as depicted in the graphic labeled as S**150'** in FIG. **3**A. Thus, if the user's BAC (i.e., the intoxication metric) is 0.03% at a first time point of the set of time points and an average elimination rate for a population of individuals is 0.015% per hour, the predicted temporal profile can characterize a decline in the user's BAC from 0.03% at the first time point to 0.00% two hours from the first time point. In another example, also shown in FIG. **3**A, two values of an intoxication metric, determined for time points after which the user has ceased alcohol consumption, can be used to determine a slope for a region of the predicted temporal profile over which the user's intoxication is declining. Thus, if the user's BAC (i.e., the intoxication metric) is 0.05% at a first time point and 0.03% one hour after the first time point, the predicted temporal profile can characterize a decline in the user's BAC at a rate of 0.02% per hour, which is a customized rate for the user.

In the above variations and examples, the predicted temporal profile, including regions of rising, peaking, and declining intoxication, can further be adjusted and customized to the user, based upon the supplementary dataset. In variations, the user's alcohol absorption profile and/or elimination rate can be adjusted based upon the demographic profile of the user, as shown in FIG. **3**B, as contained in the supplementary information. In one example, the predicted temporal profile can incorporate assumptions of a decreased alcohol absorption rate, an increased alcohol elimination rate and/or a BAC lower than average across all time points for a given number of alcoholic drinks consumed, given that the user is a male in his early 20's with a higher than average body mass index, a low fat-to-muscle ratio, and a family history of high tolerance to alcohol. In another example, the predicted temporal profile can incorporate assumptions of an increased alcohol absorption rate, a decreased alcohol elimination rate and/or a BAC higher than average across all time points for a given number of alcoholic drinks consumed, given that the user is a post-menopausal diabetic female with a lower than average body mass index, a high fat-to-muscle ratio, and a family history of low tolerance to alcohol. These examples are depicted in the graphic labeled as S**150"** in FIG. **3**B. In another example, the predicted temporal profile can incorporate assumptions of an increased alcohol absorption rate, a decreased alcohol elimination rate and/or a BAC higher than average across all time points for a given number of alcoholic drinks consumed, given that the user has been diagnosed with any one or more of: deficiencies in alcohol dehydrogenase, deficiencies in aldehyde dehydrogenase, diabetes, hypertension, depression, and epilepsy. As such, the predicted temporal profile can be adjusted relative to a population average profile of intoxication characteristics, based upon specific demographic features of the user.

In variations of Block S**150**, the user's alcohol absorption profile and/or elimination rate can be additionally or alterna-

tively adjusted based upon the user's physiological or metabolic state, as contained in the supplementary dataset. As such, as shown by the graphic labeled S**150**''' in FIG. **3**C, data related to any one or more of: food consumption, beverage consumption, medication usage, activity, biometric information, emotional state, and any other suitable factor near a time point represented in the predicted temporal profile can be used to adjust an alcohol absorption profile and/or elimination rate. In one example, a region of rising intoxication in the predicted temporal profile can incorporate a decreased alcohol absorption rate and a lower peak BAC value post-consumption of a large meal, as identified within image data contributing to the supplementary dataset. In one example, a region of falling intoxication in the predicted temporal profile can incorporate an increased alcohol elimination rate post-consumption of a large meal, as identified within image data contributing to the supplementary dataset. In another example, a region of rising intoxication in the predicted temporal profile can incorporate an increased alcohol absorption rate and higher peak BAC value upon determination that the user is consuming alcohol on an empty stomach, as identified with the supplementary dataset (e.g., no images showing food consumption, no user input of information relating to a consumed meal, no check-ins at a food vendor location, GPS-based determination that the user has not visited a food vendor, etc.). In another example, a region of rising intoxication in the predicted temporal profile can incorporate an increased alcohol absorption rate and higher peak BAC value if the supplementary dataset includes biometric data indicating that the user is experiencing stress (e.g., fast heart rate, fast respiration rate, large pupil diameter, high neural activity, etc.). In another example, a region of rising intoxication in the predicted temporal profile can incorporate an increased alcohol absorption rate and higher peak BAC value if the supplementary dataset includes data indicating that the user has consumed carbonated beverages (e.g., as identified using image data).

In any of the above variations and examples, customized aspects (e.g., elimination rates, absorption rates, intoxication peak characteristics, etc.) of the user's predicted temporal profile can be stored, used, and/or re-evaluated for future assessments of the user's intoxication. As such, a historical dataset (e.g., including at least one previously generated performance dataset and at least one previously generated predicted temporal profile) from the user can be used to refine predictions of alcohol absorption and/or elimination characteristics of the user, to increase the accuracy of the predicted temporal profile. In some variations, the method **100** can further include generating a prediction of a present value of the intoxication metric for the user, based upon the user's performance of the sobriety task (e.g., from the performance dataset). Thus, in an example, a user's score on the sobriety task can be used to determine an approximate current BAC value for the user, for instance, when the user is not near a sample receiving module. Furthermore, as shown in FIG. **4**, the users predicted temporal profile can be rendered in some visual form (e.g., graphical form, text-based form), which can be provided to the user or other suitable entity (e.g., as part of Block S**170**) an example of which is labeled as S**155** in FIG. **4**. In examples, a predicted temporal profile of BAC vs. time, customized to the user, can be rendered as a line graph with selectable regions that associate future time points with predicted BAC values for the user. The user's customized alcohol absorption and elimination rates can also be rendered or communicated, as well as any other suitable information.

Block S**160** recites: generating an analysis of the user's sobriety based upon the performance dataset and the predicted temporal profile, and functions to provide a customized analysis of the user's past, present, and/or future intoxication state(s), so that the user is able to effectively monitor his/her intoxication. The analysis preferably incorporates the predicted temporal profile, with a distribution of the intoxication metric for the user over a given time window. The analysis also preferably includes an assessment of the user's performance of the sobriety task, as determined from the performance dataset, which can be represented as one or more scores that represent the user's performance of the sobriety task at time points captured in the predicted temporal profile. For each relevant time point, the score(s) generated from the performance dataset are preferably based upon one or more of: a total response time (e.g., response time to complete a task) to complete the sobriety task, an average response time across repeat performances of the sobriety task, a deviation in response time between repeat performances of the sobriety task, a total reaction time (e.g., reaction time to a stimulus of the sobriety task), an average reaction time across repeat performances of the sobriety task, a deviation in reaction time between repeat performances of the sobriety task, and any other suitable quantified variable. Additionally or alternatively, the score(s) generated from the performance dataset can be based upon one or more of: a qualitative measure of performance success (e.g., the user accomplished the task, the user did not accomplish the task) converted to a binary score (e.g., 1=accomplishment, 0=failure), performance speed (e.g., fast, medium, slow) converted to a quantization (e.g., fast to slow performance mapped on a 1-10 scale), reaction response (e.g., user reacted, user did not react) converted to a binary score, and any other suitable factor. Thus, for at least one point on the predicted temporal profile, the analysis provides a sobriety task score that associates the user's abilities, as assessed by the sobriety task, with an intoxication state as assessed by the intoxication metric.

In Block S**160**, the analysis can also associate or annotate data points along the predicted temporal profile with user activities (e.g., meal consumption details and times, beverage consumption details and times, biometric data events, exercise events, medication events, rest events, etc.), as provided within the supplementary dataset or other suitable source. In one example, image and/or text data (e.g., images of meals, images of beverages, status updates, etc.) of the supplementary dataset can be used to annotate the predicted temporal profile, as shown in FIGS. **5**A-**5**B, based upon time stamps of the image and/or text data, as depicted by the graphic labeled S**160**' in FIG. **5**B. Furthermore, the analysis can be rendered in any suitable manner (e.g., tabulated format, graphical format, textual format, audio format, etc.) at a user interface or other interface, such that the comprehensive analysis is provided to the user and/or another entity. Additionally, the analysis or a derivative of the analysis can be co-presented with assumptions and factors (e.g., demographic factors, physiological state factors, etc.) used to customize the analysis to the user.

Block S**170** recites: providing a notification to the user based upon the analysis, and functions to provide an alert, recommendation, and/or information that informs the user of an effect of intoxication on his/her present or future behavior. The notification can include a notification of any suitable type (e.g., visual notification, haptic notification, audio notification, etc.), and can be provided to the user in any suitable manner (e.g., using a messaging client accessible by the user, at a mobile device of the user, by a supervisor of the user, etc.). The notification can be provided automatically based upon a given alert state (e.g., an automated notification upon detection that the user is entering a dangerous intoxication state),

and/or can be provided when prompted by the user or other entity. The notification preferably informs the user of his/her current intoxication state, as shown in FIG. **4**, which in examples informs the user that he or she is: currently above a legal limit of intoxication (e.g., for operating a vehicle), currently below a legal limit of intoxication, or currently at an unknown intoxication state relative to a legal limit of intoxication. In further examples, the notification can inform the user that he or she is: currently below a legal limit of intoxication, but should not perform relevant activities (e.g., operating a vehicle, operating machinery) due to poor performance of the sobriety task, currently at an unknown intoxication state relative to a legal limit of intoxication, but should not perform relevant activities (e.g., operating a vehicle, operating machinery) due to poor performance of the sobriety task, or currently above a legal limit of intoxication and should not perform relevant activities, even though the user has performed the sobriety task well.

The notification can additionally or alternatively inform the user of a predicted future intoxication state, which, in examples informs the user that he or she will be: above a legal limit of intoxication (e.g., for operating a vehicle) at a future time point, below a legal limit of intoxication at a future time point, or at an unknown intoxication state relative to a legal limit of intoxication at a future time point. Furthermore, the notification regarding a predicted future intoxication state can be governed by an input from the user or other entity. As such, in variations, Block S**160** can include allowing the user to input a request for information regarding a future intoxication state, and providing the notification based upon the request. In one example, a user can thus request information for when his/her BAC will return to zero (or any other suitable value), and the notification can provide an answer with or without a degree of certainty in the prediction. In another example, the user can request information regarding an effect of a consumed meal or beverage on his/her intoxication at a future time point, and the notification can provide an answer (e.g., a predicted BAC value at the future time point) with or without a degree of certainty in the prediction.

The notification can additionally or alternatively inform the user of an analyzed past intoxication state, which, in examples informs the user that he or she was: above a legal limit of intoxication (e.g., for operating a vehicle) at a past time point, below a legal limit of intoxication at a past time point, or at an unknown intoxication state relative to a legal limit of intoxication at a past time point. The notification can also be coupled with contextual information for the past time point, such as information provided in the supplementary dataset. In one example, the notification can inform the user of a BAC level at a past time point, and the location of the user when the user demonstrated the BAC level, which can help the user identify the location at which he/she lost an item in a state of inebriation. In another example, the notification can inform the user of a BAC level at a past time point, and an activity of the user (e.g., exercise activity, stress state, medication state), when the user demonstrated the BAC level, which can help the user identify correlations between the user's activities and the user's intoxication states.

The notification can additionally or alternatively indicate past, current, and/or future alcohol-induced behavior and/or impairment of the user. In variations, the notification can provide a BAC value for a past, current, or future time point, along with typical behavior and/or impairment information. In examples of these variations, the notification can include one or more of: an identified BAC in the range of 0.010-0.029, which produces normal behavior and subtle impairment effects; an identified BAC in the range of 0.030-0.059, which produces mild euphoria, relaxation, joyousness, talkativeness, decreased inhibition, and impairment of the user's concentration; an identified BAC in the range of 0.060-0.090, which produces blunted feelings, disinhibition, extroversion, impairment of reasoning, impairment of depth perception, impairment of peripheral vision, and impairment of glare recovery; an identified BAC in the range of 0.100-0.190, which produces over-expression, emotional swings, anger, sadness, boisterousness, decreased libido, impairment of reflexes, impairment of reaction time, impairment of gross motor control, impairment of speech, erectile dysfunction, and alcohol poisoning; an identified BAC in the range of 0.200-0.290, which produces stupor, loss of understanding, impaired sensations, possibility of falling unconscious, severe motor impairment, loss of consciousness, and blackout; an identified BAC in the range of 0.300-0.390, which produces severe central nervous system depression, unconsciousness, possibility of death, bladder dysfunction, breathing impairment, and disequilibrium; an identified BAC in the range of 0.400-0.500, which produces general lack of behavior, unconsciousness, possibility of death, breathing impairment, and nystagmus; and an identified BAC greater than 0.500, which produces high risk of poisoning, and possibility of death.

In some variations, Block S**170** can further include enabling the user to provide an input indicative of an estimated intoxication state of the user S**171**, generating a comparison between the estimated intoxication state of the user and an actual intoxication state of the user S**172**, and providing a notification to the user, wherein the notification is configured to facilitate convergence of the estimated intoxication state and the actual intoxication state S**173** in instances of future alcohol consumption. Blocks S**171**, S**172**, and S**173** function to train the user in becoming more aware of his/her actual intoxication state, such that the user can more effectively estimate his/her intoxication levels during alcohol consumption. The estimated intoxication state and/or the actual intoxication state can be a past, present, or future intoxication state, such that the user can be trained to estimate past, present, and/or future states of intoxication during alcohol consumption.

In Block S**171**, the input is preferably provided by the user by way of an application executing at a mobile device of the user, wherein the mobile device is in communication with a processing module configured to analyze the input in relation to the actual intoxication state of the user. However, in Block S**171** the input can be received by way of an input module coupled to or integrated with a system for monitoring respiration, as described in Section 2 below, and/or in any other suitable manner. In variations, Block S**171** includes allowing the user to provide an estimated BAC level (e.g., past, present, or predicted future BAC level); however, any other quantitative or qualitative estimated intoxication state (e.g., cognitive ability, motor skill ability, etc.) can be provided in other variations of Block S**171**. The comparison generated in Block S**172** preferably calculates a difference between the estimated and the actual intoxication states of the user; however, the comparison can additionally or alternatively calculate any other suitable metric (e.g., a change in difference between estimated and actual intoxication state, relative to at least one past estimate of intoxication state) configured to train the user in identifying his/her actual intoxication state at a given state in time. In Block S**173**, the notification can be provided to the user in any one or more of: a visual manner (e.g., at a display), a haptic manner (e.g., using a vibration motor), an auditory manner (e.g., using a speaker), and in any other suitable manner that indicates the user's level of success in predicting

his/her intoxication state. In specific applications, Blocks S**171**-S**173** can enable the user to input an estimate of his/her BAC at an input module (e.g., keyboard, touchpad, touchscreen, voice recognition module, etc.) of a mobile device included in or coupled to system for monitoring intoxication, and providing the notification at a display of the mobile device in a visual manner.

As shown in FIG. **1**, the method **100** can further comprise Block S**180**, which recites: generating a longitudinal prediction of an effect of the user's alcohol consumption, based upon the set of signals and the analysis. Block S**180** functions to enable a determination of a change in the user's alcohol tolerance level over time, which can be used to inform the user of adverse effects of alcohol consumption or abuse. The longitudinal prediction is preferably based upon accumulated analyses, such as analyses generated in multiple instances of Block S**160**, but can be formed based upon any other suitable data. In variations, the longitudinal prediction is based upon tracking of the user's intoxication metric values (e.g., from predicted temporal profiles) for given amounts of alcohol consumed over time, in relation to changes in any one or more of: performance of the sobriety task, behavior, impairment, weight gain, weight loss, metabolism, organ damage, organ recovery, and any other suitable expression of intoxication.

As shown in FIGS. **1** and **6**, the method **100** can further comprise Block S**190**, which recites: guiding the user in at least one of providing the set of samples and performing the sobriety task. Block S**190** functions to ensure that the user has provided the set of samples properly, and/or to provide the user with instructions in performing the sobriety task. In guiding the user in providing the set of samples, Block **190** is preferably implemented at a sample collection module and/or a user interface of an application executing at an electronic device (e.g., mobile device) of the user; however, guiding the user in providing the set of samples can additionally or alternatively be performed in any other suitable manner. In guiding the user in performing the sobriety task, Block **190** is preferably implemented at a user interface of an application executing at an electronic device (e.g., mobile device) of the user; however, guiding the user in performing the sobriety task can additionally or alternatively be performed in any other suitable manner. In variations of the method **100** including guiding the user in providing the set of samples, Block S**190** preferably includes providing instruction to the user in one or more of a visual format, an auditory format, and a haptic format, but can additionally or alternatively include providing instruction to the user in any other suitable format. Furthermore, Block S**190** can include pairing of a user interface, at which guidance of the user is provided, with a sample collection module by a wired and/or a wireless link (e.g., Bluetooth, WiFi). In examples, providing instruction can thus be implemented using one or more of a display (e.g., of a mobile device of the user and/or a display of a sample collection module), a speaker unit (e.g., of a mobile device and/or of a sample collection module), a lighting module (e.g., an LED array of a mobile device and/or of a sample collection module), and a vibration motor (e.g., of a mobile device and/or of a sample collection module).

In a specific example of guiding the user in providing the set of samples, Block S**190** is implemented at a mobile device coupled with a breathalyzer module. In the specific example, Block S**190** includes: providing text instructions at a display of the mobile device that guide the user in pairing of the mobile device with the breathalyzer module S**191**, and prompting the user to initiate provision of a sample of the set of samples S**192**. The specific example further includes receiving an input from the user to indicate initiation of sample provision S**193** (e.g., by selecting a button, by speaking into the mobile device), which causes the mobile device to send an initiation signal to the breathalyzer module. Block S**193** thus facilitates activation of the breathalyzer, which can include any one or more of warming up the breathalyzer, burning off excess alcohol, calibrating the breathalyzer, and any other suitable step. The specific example further includes providing visual instructions at the display that guide the user in providing a breath sample by blowing into the breathalyzer module S**194** (e.g., by using a graphical object that indicates the amount of time that the user needs to blow into the breathalyzer). In the specific example, a microphone within the breathalyzer module senses that the user is providing the sample, and transmits a signal to the mobile device to indicate that the user is providing the breath sample. An application executing at the mobile device can then display an indicator (e.g., a countdown indicator) to guide the user in providing the breath sample over an adequate duration of time. If the user provides an inadequate breath sample, the application can provide an error notification to the user. In variations of the specific example, guiding the user can further include indicating at least one of an air flow parameter and a force of blowing (e.g., using a pressure sensor, using a flow sensor) provided by the user S**195** at a display of the mobile device and/or the breathalyzer module, and indicating improper breath sample provision if the air flow parameter and/or the force of blowing does not satisfy a threshold condition S**196**. The specific example thus provides greater assurance that the user has properly provided a sample of the set of samples.

In variations of the method **100** including guiding the user in performing the sobriety task, Block S**190** can include providing instruction to the user in one or more of a visual format, an auditory format, and a haptic format, but can additionally or alternatively include providing instruction to the user in any other suitable format. In examples analogous to those described above, providing instruction can thus be implemented using one or more of a display (e.g., of a mobile device of the user), a speaker unit (e.g., of a mobile device), a lighting module (e.g., an LED array of a mobile device), and a vibration motor (e.g., of a mobile device). The guidance in Block S**190** is thus provided in a consistent format that strengthens analyses generated from the user's performance of the sobriety task.

Also shown in FIG. **1**, the method **100** can further comprise Block S**210**, which recites: transmitting at least one of the predicted temporal profile, the analysis, and the notification to an entity. Block S**210** functions to share at least one aspect related to the user's intoxication state with another entity (e.g., caretaker, friend, family member, supervisor) associated with the user, which can facilitate monitoring of the user's intoxication. The transmission preferably shares at least one of the predicted temporal profile, the analysis, and the notification in a secure manner (e.g., over a private message, with a unique URL, etc.), but can alternatively involve sharing in a non-secure manner. In variations, at least one of the predicted temporal profile, the analysis, and the notification can be provided to the entity along with any relevant activity and/or location information, as provided in the supplementary dataset. In examples, the notification can thus allow the entity to locate the user even when the user is unable or unwilling to communicate, and can prepare the entity to accommodate the intoxication state of the user (e.g., by sending a taxicab to pick the user up). In these examples and variations, the notification can also be provided in any suitable manner (e.g., messaging client, by a social network, etc.).

The method **100** can further include any other suitable blocks or steps that facilitate monitoring of a user's intoxication. Additionally, as a person skilled in the field of intoxication monitoring devices will recognize from the previous detailed description and from the figures and claims, modifications and changes can be made to the embodiments, variations, examples, and specific applications of the method **100** described above without departing from the scope of the method **100**.

2. System

As shown in FIGS. **7**A-**7**C, an embodiment of a system **200** for monitoring intoxication of a user includes: a sample receiving module **210** configured to accept a set of breath samples of the user at a set of time points; a sample processing module **230** configured to analyze the set of breath samples; an electronics subsystem **240** comprising a power module **241** configured to power the sample processing module **230** and a conditioning module **243** configured to process signals generated by a sensor of the sample processing module **230**; a data link **248** coupled to the sample processing module and configured to communicate a set of signals derived from the set of breath samples; and a processor **250** including a first module **252** configured to receive the set of signals, a supplementary dataset, and a performance dataset characterizing the user's performance of a sobriety task proximal to at least one time point of the set of time points; a second module **254** configured to determine a set of values of an intoxication metric, derived from the set of signals; a third module **256** configured to generate a predicted temporal profile of the intoxication metric for the user based upon the set of values, the set of time points, and the supplementary dataset; a fourth module **258** configured to generate an analysis of the user's sobriety as derived from the performance dataset, and a fifth module **260** configured to generate a notification based upon the predicted temporal profile and the analysis. The system **200** can further include any other suitable element that facilitates monitoring of the user's intoxication, such as a storage module **270** configured to store and/or transmit at least one of the analysis, the notification, and the predicted temporal profile.

The system **200** functions to provide a tool that allows a user to monitor his/her alcohol consumption and behavioral effects of intoxication in a compelling and intuitive manner. The system **200** can also guide a user's behavior at various stages of intoxication, by providing notifications related to the user's intoxication state. In this regard, the system can provide short-term and/or long-term predictions of a state of the user, in quantitative and qualitative manners, such that the user learns about the physiological and/or behavioral effects of his/her alcohol consumption. The system **200** can also incorporate a social component, wherein information related to a user's intoxication-induced behavior and/or physiological state can be communicated to another entity (e.g., a supervisor, a caretaker, a family member, an acquaintance).

2.1 System—Sample Receiving Module

The sample receiving module **210** includes a body **212** defining a cavity **215** configured to accept the set of breath samples of the user at a set of time points, and functions to provide a module that facilitates reception and processing of the set of breath samples.

The body **212** is configured to enclose at least a portion of the system **200**, and functions to protect elements of the system **200** over the lifetime usage of the system **200**. In some embodiments, the body can further function to enhance portability of the system **200**, such that the user can conveniently bring the sample receiving module wherever he/she goes. As shown in FIG. **7**B, the body **212** can include a first body portion **213** and a second body portion **214** coupled together to form an interior chamber. In some variations, at least one of the first body portion **213** and the second body portion **214** can include a transparent or translucent portion **299** that allows elements within the body **212** to be visible or identifiable. However, in other variations, the first body portion **213** and the second body portion **214** can be substantially opaque to hide elements within the body **212**. The body **212** is preferably composed of a polymer (e.g., polystyrene) that is processed to define features of the body (e.g., by machining, by injection molding, by casting, by printing, etc.); however, the body can alternatively be composed of any other suitable material and processed by any other suitable process. In a specific example, as shown in FIG. **7**B, the first body portion **213** and the second body portion **214** couple together to form an approximately rectangular prism with rounded corners, wherein the first body portion **213** includes a transparent portion **299** located at the periphery of the first body portion **213** that allows visualization of elements internal to the body **212**.

The cavity **215** is preferably included within a portion of the interior chamber of the body **212**, is coupled to the sample processing module **230**, and comprises a first aperture **216** and a second aperture **217**, in communication with the first aperture **216**, configured to facilitate sample inflow and outflow. The cavity **215** thus functions to facilitate transmission of a sample from the user to be analyzed by the sample processing module **230**. The first aperture **216** and the second aperture **217** can be substantially identical in geometry, such that the cavity has an axis of symmetry (e.g., longitudinal axis of symmetry, transverse axis of symmetry), and such that each of the first aperture **216** and the second aperture **217** can function as both a sample inlet and a sample outlet; however, the first aperture **216** and the second aperture **217** can alternatively be non-identical in geometry or in any other suitable manner, as shown in FIG. **7**B, such that the cavity **215** has an orientation that is identifiable by the user and is configured to only receive a sample from one of the first aperture **216** and the second aperture **217**. In one variation, the cavity **215** can be defined by a tube form factor, as shown in FIG. **7**B; however, the cavity **215** can alternatively be defined by any other suitable form factor that facilitates transmission of the sample from the user. The cavity **215** can be of unitary construction with the body **212**, can be physically coextensive with the body **212**, or can be coupled to the body **212** (e.g., to an interior portion of the body **212**, to an exterior portion of the body **212**) in any other suitable manner. Similar to the body **212**, the cavity **215** can also include a transparent or translucent portion that can be illuminated (e.g., by a lighting module) to provide an indicator function for the user. In a specific example, as shown in FIG. **7**B, the cavity **215** is partially coupled to the body **212** by a housing **218** that couples the cavity **215** to a peripheral portion of the body **212**, wherein the housing **218** includes apertures that align with and provide access to the first aperture **216** and the second aperture **217**.

In some variations, the sample receiving module **210** can further include a mouthpiece **219** configured to mechanically couple (e.g., with protrusions/depressions, with slots, with keys, with tabs, with threads, by press fit, etc.) to at least one of the first aperture **216** and the second aperture **217**, in order to facilitate sample reception from the user. The mouthpiece **219** can be configured to permanently couple to at least one of the first aperture **216** and the second aperture **217**, semi-permanently couple to at least one of the apertures **216**, **217**, or reversibly couple to at least one of the apertures **216**, **217**. Furthermore, the mouthpiece **219** can define unique identifiers (e.g., colors, textures, geometric features, etc.) that facili-

tate usage of the system **200** by multiple users. In one specific example, the mouthpiece **219** is configured to be reversibly coupled to the first aperture **216**, such that the mouthpiece **219** is a disposable and replaceable element of the sample receiving module **210**. In alternative variations of the sample receiving module **210**, however, the mouthpiece **219** can be of unitary construction with one of the first aperture **216** and the second aperture **217**.

2.2 System—Sample Processing Module

The sample processing module **230** is configured to couple to the cavity **215** of the sample receiving module **210**, and functions to facilitate analysis of the set of breath samples and generation of a set of signals from the set of breath samples. As such, the sample processing module **230** preferably includes a sensor **232** coupled to an electronics subsystem **240**, wherein the sensor interacts with a sample of the set of breath samples and the electronics subsystem **240** conditions signals produced based upon the sensor-sample interaction for transmission to a processor for further analysis. The sample processing module **230** is preferably housed within the body **212** of the sample receiving module **210**, but can alternatively be configured relative to the sample receiving module **210** in any other suitable manner. The sample processing module **230** can, alternatively, include any other suitable elements that facilitate sample processing and transmission.

The sensor **232** is preferably a fuel cell sensor that enables measurement of a user's BAC by an electrochemical process. In particular, the fuel cell sensor is configured to produce an electrical current in response to oxidation of alcohol carried in a breath sample, wherein the magnitude of the produced electrical current varies in a predictable manner according to the amount (e.g., relative volume) of alcohol carried in the breath sample. As such, in some variations, the sensor **232** can be incorporated into a fuel cell subsystem including a pump **233** configured to drive a breath sample received from at least one of the first aperture **216** and the second aperture **217**, through an intake **237** toward the sensor **232**.

The sensor **232** can alternatively be a semiconductor sensor that produces a change in electrical resistance in response to an alcohol-dioxide reaction, wherein the magnitude of the change in resistance varies in a predictable manner according to the amount (e.g., relative volume) of alcohol carried in the breath sample. In a specific example, the semiconductor sensor can incorporate tin-oxide as a sensing element; however, variations of the semiconductor sensor can alternatively use any other suitable sensing element. In other variations of the sensor **232**, the sensor can include a spectrophotometer configured to produce a signal in response to absorbed or emitted light from alcohol molecules carried in the breath sample, or any other suitable type of sensor.

The electronics subsystem **240** comprises a power module **241** configured to power the sample processing module **230** and a conditioning module **243** configured to process signals generated by the sensor **232** for transmission and further analysis. As such, the electronics subsystem **240** functions to provide power to elements of the system **200**, condition and/or preprocess signals generated from received breath samples, and facilitate transmission of signals to a processor for further analysis. The electronics system **240** preferably incorporates or is configured to couple to a data link **248** for transmission of signals from the sample processing module **230** to a processor for further processing and analysis. Preferably, the electronics subsystem **240** complies with relevant technical and safety standards, such that the system **200** is configured for "home-use"; however, the electronics subsystem can be configured in any suitable manner.

The power module **241** of the electronics subsystem **240** functions to provide regulated and unregulated electrical power to the sample processing module **230** and to allow power storage for the sample processing module **230**. The power module **241** preferably comprises a battery **242**, such as a lithium-ion battery that is configured to be rechargeable, but can alternatively comprise any other suitable rechargeable battery (e.g., nickel-cadmium, metal halide, nickel metal hydride, or lithium-ion polymer). Alternatively, the power module **241** can comprise a non-rechargeable battery (e.g., alkaline battery) that can be replaced to further enhance modularity in the system **200**. The power module **241** can be configured to have any appropriate profile such that the power module **241** provides adequate power characteristics (e.g., cycle life, charging time, discharge time, etc.) for the sample processing module **230** within physical constraints provided by the body **212** of the sample receiving module **210**.

In variations where the battery **242** of the power module **241** is rechargeable, the electronics subsystem **240** can also comprise a coil of wire and associated electronics that function to allow inductive charging of the battery by an external power source and the power module **241**. Inductive charging provided by the charging coil thus also facilitates patient mobility while interacting with the system **200**, such that the patient can be extremely mobile while monitoring his/her intoxication. In alternative variations, however, the charging coil can be altogether omitted (e.g., in variations without a rechargeable battery), or replaced or supplemented by a connection **244** (e.g., USB connection) configured to provide wired charging of a rechargeable battery.

The conditioning module **243** functions to preprocess signals generated by the sensor **232** prior to transmission from the sample processing module **230**, and can additionally function to regulate elements of the electronics subsystem **240**. The conditioning module preferably comprises signal conditioning elements, including one or more of: an analog-to-digital converter (e.g., to convert analog signals sensor **232**), an amplifier, and a filter for processing signals prior to transmission. In some variations, the conditioning module **243** can include a microprocessor configured to direct signal conditioning functionalities of the conditioning module **243** and a voltage regulator configured to protect elements of the electronics subsystem **240** from overvoltage and/or under-voltage states.

The electronics subsystem **240** can additionally or alternatively comprise any other suitable element that facilitates intoxication monitoring. Furthermore the electronics subsystem **240** can be coupled to a user control module **245** that interfaces with the electronics subsystem **240**, such that manual control of any aspect of the sample receiving module **210** and/or the sample processing module **230** can be performed by the user or any other suitable entity. The user control module **245** can comprise a power toggle (e.g., on/off button) for activating and/or deactivating the sample receiving module **210**. The user control module **245** can further include input devices that allow the user to indicate initiation of sample provision. Preferably, the user control module **245** provides a minimal number of controls (e.g., an on/off button, a sample provision initiation button), but can provide any suitable number of manual controls. The user control module **245** can be touch-activated (e.g., with a touch screen, buttons, dials, knobs, sliders), or can be activated using any other suitable manner (e.g., sound activation). Preferably, the user control module **245** is integrated with the electronics subsystem **240**, but in other alternative variations, the user control module **245** can be implemented remotely from the sys-

tem sample processing module **230**, for example, using an application executing on a mobile device of the patient.

The data link **248** functions to transmit an output of at least one element of the electronics subsystem **240** to one or more of: a mobile device **202**, a processor **250**, and any other suitable computing device (e.g., desktop computer, laptop computer, tablet, smartphone, health tracking device, server, cloud). Preferably, the data link **248** is a wireless interface; however, the data link **248** may alternatively be a wired connection. In a first variation, the data link **248** can include a Bluetooth module that interfaces with a second Bluetooth module included in the mobile device or external element, wherein data or signals are transmitted by the data link **248** to/from the mobile device or external element over Bluetooth communications. The data link of the first variation can alternatively implement other types of wireless communications, such as 3G, 4G, radio, or Wi-Fi communication. In the first variation, data and/or signals are preferably encrypted before being transmitted by the data link **248**. For example, cryptographic protocols such as Diffie-Hellman key exchange, Wireless Transport Layer Security (WTLS), or any other suitable type of protocol may be used. The data encryption may also comply with standards such as the Data Encryption Standard (DES), Triple Data Encryption Standard (3-DES), or Advanced Encryption Standard (AES).

In a second variation, the data link **248** is a wired connection such that the electronics subsystem **240** can communicate with the mobile device and/or any external computing element through a jack of the mobile device and/or external computing element. In one specific example of the data link **248** that includes a wired jack, the data link **248** is configured only to transmit output signals from the electronics subsystem **240**. In another specific example, the data link **248** is configured to transmit data to and from at least one element of the electronics subsystem **240** and a mobile device (e.g., for pairing of the mobile device and the electronics subsystem, for synchronization between the mobile device and the electronics subsystem). In this example, the data link **248** can transmit output signals into the mobile device through the microphone input of the audio jack of the mobile device and can retrieve data from the audio output of the audio jack of the mobile device. In variations of this example, the data link **248** can additionally or alternatively communicate with the mobile device via inter-integrated circuit communication (I2C), one-wire, master-slave, or any other suitable communication protocol. However, the data link **248** can transmit data in any other way and can include any other type of wired connection (such as a USB wired connection) that supports data transfer between the electronics subsystem **240**, the mobile device, and/or any other suitable computing element.

2.3 System—Processor

The processor **250** includes a first module **252** configured to receive the set of signals from the sample processing module **230**, a supplementary dataset characterizing at least one of a demographic profile of the user and a physiological state of the user, and a performance dataset characterizing the user's performance of a sobriety task proximal to at least one time point of the set of time points. The processor preferably also includes a second module **254** configured to determine a set of values of an intoxication metric, derived from the set of signals; a third module **256** configured to generate a predicted temporal profile of the intoxication metric for the user based upon the set of values, the set of time points, and the supplementary dataset; a fourth module **258** configured to generate an analysis of the user's sobriety as derived from the performance dataset, and a fifth module **260** configured to generate a notification based upon the predicted temporal profile and the analysis. As such, the processor preferably functions to implement at least a portion of the method **100** described in Section 1 above, but can alternatively be configured to perform any other suitable method that facilitates monitoring of the user's intoxication. The first module **252**, the second module **254**, the third module **256**, the fourth module **258**, and the fifth module **260** can be implemented at a single processing unit, or can be implemented using multiple processing units.

2.4 System—Other Elements

The system **200** can additionally further comprise a storage module **270**, which functions to retain data generated during use of the system **200**. The storage module **270** can be implemented with any one or more of: the electronics subsystem **240**, mobile device, personal computer, web browser, external server (e.g., cloud), local server, and any combination of the above, in a network configured to transmit, store, and receive data. Preferably, data from the storage module **270** is automatically transmitted to any appropriate external device continuously; however, data from the storage module **270** can alternatively be transmitted intermittently (e.g. every minute, hourly, daily, or weekly). In one example, data generated by any element can be stored on a portion of the storage module **270** when the data link **248** is not coupled to an element external to the electronics subsystem **240**. However, in the example, when a link is established between the data link **248** and an external element, data may then be automatically transmitted from the storage module **270**. In other examples, the storage module **270** can alternatively be manually prompted to transmit stored data by a user or other entity.

As shown in FIG. **7**A, the system **200** can additionally include a supplementary sensing module **280** configured to communicate with the processor **250**, wherein the supplementary sensing module functions to facilitate reception and/or generation of data related to any one or more of: food consumption (e.g., amount/rate of consumption), beverage consumption (e.g., amount/rate of consumption), medication usage, activity (e.g., exercise, rest, sleep), biometric information (e.g., heart rate, respiration rate, pupilometric information, neural activity information, etc.), emotional state (e.g., stress state), user location information, and another other suitable type of supplementary information (e.g., environmental data). As such, the supplementary sensing module **280** can include any one or more of: an image sensor **281** (e.g., for generation of image data related to food, drink, or medication usage), an accelerometer **282** (e.g., for activity data), a gyroscope **283** (e.g., for activity data), a location sensor **284** (e.g., GPS), and a biometric sensor **285** (e.g., heart rate monitor, respiration sensor, blood pressure sensor, electroencephalogram activity sensor, etc.). The supplementary sensing module can also include a manual input module **286** configured to receive manual inputs from the user or another entity that provides supplementary data. In some variations, involving automated generation of a supplementary dataset as described in Section 1 above, the supplementary sensing module **280** can include an aggregation module **287** configured to access, retrieve, and/or aggregate content (e.g., digital content) from different sources (e.g., social network accounts, search results, etc), and can additionally include object recognition and/or text recognition modules **288**, **289**, respectively to enable automatic identification of items that the user consumes. The supplementary sensing module can additionally comprise a tagging module configured to tag supplementary data with time information to facilitate analysis and processing of data by the processor **250**.

As shown in FIG. **8**, the system **200** can additionally include an indicator module **290**, which functions to guide the

user in properly providing a sample of the set of samples. The indicator module **290** can be implemented using an application executing at a mobile device of the user, and in variations, can incorporate functions of one or more of: a display of the mobile device, an LED of the mobile device, a speaker of the mobile device, a vibration motor of the mobile device, and any other suitable element of the mobile device. The indicator module **290** can additionally or alternatively be implemented using a lighting module **291** configured to couple to the sample receiving module **210** and the sample processing module **230**. One variation of the lighting module **291** includes a set of light emitting diodes (LEDs) configured to indicate that the user should initiate provision of a breath sample, that the sample processing module **230** is processing the breath sample, and/or that the user has improperly provided a breath sample. In a specific example, as shown in FIG. **8**, the lighting module **291** includes a first LED **292** and a second LED **293** oriented proximal to the cavity **215** (e.g., a tube configured to receive the breath sample), such that the first LED **292** and the second LED **293** illuminate the cavity to provide an indicator function for the user. In the specific example, the first LED **292** functions as a visual cue that guides the user in submitting a breath sample into the cavity **215**, and the second LED **293** functions as a visual cue that indicates that the sample processing module **230** is currently processing the breath sample provided by the user. As such, the first LED **292** and the second LED **293** in the specific example are both coupled to the electronics subsystem **240** of the sample processing module **230**. Other variations of the indicator module **290** can include any other suitable indication elements in communication with any other suitable element of the system **200**.

Variations of the method **100** and system **200** include any combination or permutation of the described components and processes. Furthermore, various processes of the preferred method can be embodied and/or implemented at least in part as a machine configured to receive a computer-readable medium storing computer-readable instructions. The instructions are preferably executed by computer-executable components preferably integrated with a system and one or more portions of the control module **155** and/or a processor. The computer-readable medium can be stored on any suitable computer readable media such as RAMs, ROMs, flash memory, EEPROMs, optical devices (CD or DVD), hard drives, floppy drives, or any suitable device. The computer-executable component is preferably a general or application specific processor, but any suitable dedicated hardware device or hardware/firmware combination device can additionally or alternatively execute the instructions.

The FIGURES illustrate the architecture, functionality and operation of possible implementations of systems, methods and computer program products according to preferred embodiments, example configurations, and variations thereof. In this regard, each block in the flowchart or block diagrams may represent a module, segment, step, or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that, in some alternative implementations, the functions noted in the block can occur out of the order noted in the FIGURES. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and computer instructions.

As a person skilled in the art will recognize from the previous detailed description and from the figures and claims, modifications and changes can be made to the preferred embodiments of the invention without departing from the scope of this invention defined in the following claims.

We claim:

1. A method for monitoring intoxication of a user, comprising:

receiving a set of signals, derived from a set of breath samples collected from the body of the user at a set of time points, at a sample receiving module;

at a processing subsystem, determining a value of an intoxication metric, derived from the set of signals upon receiving information derived from the set of signals by way of a data link coupled to the processing subsystem;

at the processing subsystem, generating a predicted temporal profile of the intoxication metric for the user based upon the value of the intoxication metric and the set of time points;

at the processing subsystem, generating an analysis of the user's sobriety based upon the predicted temporal profile; and

at a device comprising a user interface, providing a notification to the user based upon the analysis, thus facilitating monitoring of the user's intoxication.

2. The method of claim **1**, wherein providing the notification to the user comprises providing the user with an indication of when the intoxication metric of the user will return to a zero value.

3. The method of claim **2**, further comprising: at the user interface of the device, receiving a supplementary dataset characterizing at least one of a demographic profile of the user and a physiological state of the user; and wherein generating the predicted temporal profile of the intoxication metric comprises generating the predicted temporal profile based upon the value of the intoxication metric, the set of time points, and the supplementary dataset.

4. The method of claim **2**, wherein determining the value of the intoxication metric includes determining a first BAC value of the user corresponding to a first breath sample of the set of samples received at a time point of the set of time points.

5. The method of claim **4**, wherein generating the predicted temporal profile includes generating the predicted temporal profile of BAC vs. time for the user, based upon the first BAC value of the user, the time point of the set of time points, and a predicted alcohol elimination rate.

6. The method of claim **1**, further comprising:

at the user interface, providing a sobriety task to the user proximal in time to at least one time point of the set of time points, wherein collection of the set of samples occurs within a time window, and providing the sobriety task occurs within the time window;

generating a performance dataset characterizing performance of the sobriety task by the user; and

generating the analysis of the user's sobriety based upon the predicted temporal profile and performance of the sobriety task by the user.

7. The method of claim **6**, wherein providing the sobriety task includes detecting performance of the sobriety task by the user at a touch screen of a mobile device including the user interface.

8. A method for monitoring intoxication of a user, comprising:

receiving a set of signals, derived from a set of breath samples collected from the body of the user at a set of time points, at a sample receiving module;

at a user interface of an electronic device of the user comprising a supplementary sensing module, receiving a supplementary dataset characterizing at least one of a demographic profile of the user and a physiological state of the user;

at a processing subsystem, determining a value of an intoxication metric, derived from the set of signals upon receiving information derived from the set of signals by way of a data link coupled to the processing subsystem;

at the processing subsystem, generating a predicted temporal profile of the intoxication metric for the user based upon the value of the intoxication metric, the set of time points, and the supplementary dataset;

at the processing subsystem, generating an analysis of the user's sobriety based upon the predicted temporal profile;

at the user interface, providing a notification to the user based upon the analysis; and

transmitting at least one of the predicted temporal profile, the analysis, and the notification to an entity associated with the user, thus facilitating monitoring of the user's intoxication.

9. The method of claim **8**, wherein transmitting comprises providing a transmission of a location of the user to the entity, by way of a location sensor of the supplementary sensing module.

10. The method of claim **8**, wherein receiving the supplementary dataset includes receiving supplementary data at an aggregation module configured to access and aggregate digital content from digital social network accounts of the user, such that the supplementary dataset comprises at least one of demographic information, location information, and activity information.

11. The method of claim **8**, wherein receiving the supplementary dataset further includes receiving supplementary data from at least one of an object recognition module and a text recognition module configured to extract supplementary data from at least one of image content and text content indicative of consumables intended to be consumed by the user.

12. The method of claim **8**, further comprising:

at a set of sample receiving modules, receiving an aggregate set of signals derived from a plurality of breath samples from bodies of a population of users, wherein signals, of the aggregate set of signals, for each of the plurality of breath samples are tagged with a location at which the breath sample was provided,

at the processing subsystem, generating a plurality of intoxication metrics, derived from the aggregate set of signals, each of the plurality of intoxication metrics associated with at least one of the plurality of breath samples,

at the processing subsystem, generating a graphical map that provides the location for each of the plurality of breath samples along with at least one parameter derived from the plurality of intoxication metrics displayed at the graphical map, and

rendering the graphical map at the user interface.

13. The method of claim **8**, further comprising guiding the user in delivering the set of breath samples, at the user interface, wherein guiding comprises providing instruction to the user in one or more of a visual format, an auditory format, and a haptic format at the user interface.

14. A method for monitoring intoxication of a user, comprising:

receiving a set of signals, derived from a set of breath samples collected from the body of the user at a set of time points, at a sample receiving module;

at a processing subsystem, determining a value of an intoxication metric, derived from the set of signals, upon receiving information derived from the set of signals by way of a data link coupled to the processing subsystem;

at the processing subsystem, generating a predicted temporal profile of the intoxication metric for the user based upon the value of the intoxication metric and the set of time points;

enabling the user to provide an input, at a user interface of an electronic device in communication with the processing subsystem, indicative of an estimated intoxication state of the user;

generating a comparison between the estimated intoxication state of the user and an actual intoxication state of the user captured in at least one of the value of the intoxication metric and the predicted temporal profile; and

providing a notification to the user at the user interface, wherein the notification is configured to inform the user of the comparison in order to train the user in becoming more aware of the actual intoxication state in relation to the estimated intoxication state, thereby facilitating monitoring of the user's intoxication.

15. The method of claim **14**, wherein generating the predicted temporal profile comprises incorporating demographic information of the user, thereby adjusting the predicted temporal profile relative to a population-average profile of intoxication characteristics, based upon demographic features of the user.

16. The method of claim **14**, further comprising:

at the user interface, providing a sobriety task to the user proximal in time to at least one time point of the set of time points, wherein collection of the set of samples occurs within a time window, and providing the sobriety task occurs within the time window; and

generating a performance dataset characterizing performance of the sobriety task by the user.

17. The method of claim **16**, further comprising generating an analysis of the user's sobriety based upon the performance dataset, and wherein providing the notification further comprises notifying the user of the analysis of the user's sobriety at the user interface.

18. The method of claim **17**, wherein providing the notification comprises providing a notification that the user is currently below a legal limit of intoxication, as determined from the value of the intoxication metric, but is impaired, based upon the analysis of the user's sobriety.

19. The method of claim **14**, further comprising generating a predicted value of the intoxication metric at a future time point outside of the set of time points, based upon the predicted temporal profile, wherein providing the notification to the user includes providing the notification informing the user of the predicted value of the intoxication metric at the future time point.

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